

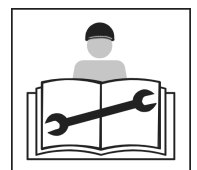


Service Manual

Models
3507, 3508,
3509, 3512,
3513, 4007,
4008, 4009,
4012, 4013

P/N - 3121852

Revised
April 20, 2007



EFFECTIVITY PAGE

June 16, 2003 - A - Original Issue Of Manual

January 20, 2006 - B - Complete Revision Of Manual

April 20, 2007 - C - Revised pages 5.3, 5.5, 5.10, 6.3, 6.5, 6.7, 8.8, & 8.20

EFFECTIVITY PAGE

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Section 1

Safety Practices

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Safety Practices

1.1 INTRODUCTION

This service manual provides general directions for accomplishing service and repair procedures. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired consult the local JLG distributor.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the machine. All references to the right side, left side, front and rear are given from the operator's seat looking in a forward direction.

Supplementary information is available from JLG in the form of Service Bulletins, Service Campaigns, Service Training Schools, the JLG website, other literature, and through updates to the manual itself.

1.2 DISCLAIMER

All information in this manual is based on the latest product information available at the time of publication. JLG reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.3 OPERATION & SAFETY MANUAL

The mechanic must not operate the machine until the Operation & Safety Manual has been read & understood, training has been accomplished and operation of the machine has been completed under the supervision of an experienced and qualified operator.

An Operation & Safety Manual is supplied with each machine and must be kept in the cab. In the event that the Operation & Safety Manual is missing, consult the local **JLG** distributor before proceeding.

1.4 DO NOT OPERATE TAGS

Place Do Not Operate Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Remove key and disconnect battery leads.



1.5 SAFETY INFORMATION

To avoid possible death or injury, carefully read, understand and comply with all safety messages.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

1.5.1 Safety Alert System and Signal Words



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider ***before*** performing maintenance procedures on the telehandler. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions ***before*** proceeding.

1.6.1 Personal Hazards

PERSONAL SAFETY GEAR: Wear all the protective clothing and personal safety gear necessary to perform the job safely. This might include heavy gloves, safety glasses or goggles, filter mask or respirator, safety shoes or a hard hat.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.



Safety Practices

1.6.3 General Hazards

SOLVENTS: Only use approved solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator's cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection, and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the machine to capture fluid run-off.

Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.

1.6.4 Operational Hazards

ENGINE: Stop the engine before performing any service unless specifically instructed otherwise.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

SOFT SURFACES AND SLOPES: **NEVER** work on a machine that is parked on a soft surface or slope. The machine must be on a hard level surface, with the wheels blocked before performing any service.

FLUID TEMPERATURE: **NEVER** work on a machine when the engine, cooling or hydraulic systems are hot. Hot components and fluids can cause severe burns. Allow systems to cool before proceeding.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an

appropriate container and dispose of in accordance with prevailing environmental regulations.

RADIATOR CAP: Always wear steam-resistant, heat protective gloves when opening the radiator cap. Cover the cap with a clean, thick cloth and turn slowly to the first stop to relieve pressure.

FLUID FLAMABILITY: **DO NOT** service the fuel or hydraulic systems near an open flame, sparks or smoking materials.

NEVER drain or store fluids in an open container. Engine fuel and hydraulic fluid are flammable and can cause a fire and/or explosion.

DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING MACHINE: Lower the forks or attachment to the ground before leaving the machine.

TIRES: Always keep tires inflated to the proper pressure to help prevent tipover. **DO NOT** over-inflate tires.

NEVER use mismatched tire types, sizes or ply ratings. Always use matched sets according to machine specifications.

MAJOR COMPONENTS: Never alter, remove, or substitute any items such as counterweights, tires, batteries or other items that may reduce or affect the overall weight or stability of the machine.

BATTERY: **DO NOT** charge a frozen battery. Charging a frozen battery may cause it to explode. Allow the battery to thaw before jump-starting or connecting a battery charger.

1.7 SAFETY DECALS

Check that all safety decals are present and readable on the machine. Refer to the Operation & Safety Manual supplied with machine for information.



Section 2

General Information and Specifications

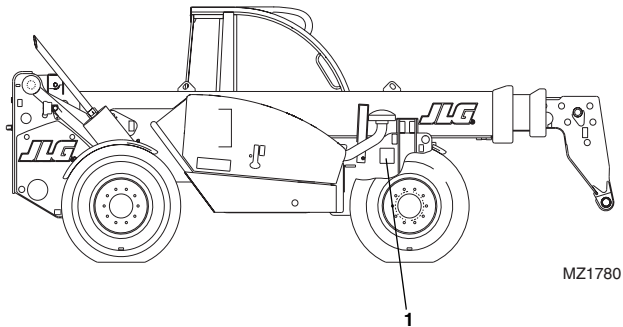
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2.1 REPLACEMENT PARTS AND WARRANTY INFORMATION

For reference when ordering replacement parts or making service inquiries about the machine, the machine serial number is required to help assure the provision of correct parts and information. Before ordering parts or initiating service inquiries, make note of the serial number located on the serial number plate (1).



IMPORTANT: The replacement of any part on this machine with any other than a **JLG** authorized replacement part can adversely affect the performance, durability, or safety of the machine, and will void the warranty. **JLG** disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.

A warranty registration form must be filled out by the **JLG** distributor, signed by the purchaser and returned to **JLG** when the machine is sold and/or put into use.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed. To guarantee full warranty service, verify that the distributor has returned the business reply card of the warranty registration form to **JLG**.



2.2 TORQUES

2.2.1 ASTM Fastener Torque Chart (English)


VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY																UNPLATED CAP SCREWS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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					DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	IN-LB		IN-LB	IN-LB	IN-LB	IN-LB	IN-LB		IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB	IN-LB




General Information and Specifications

2.2.2 ASTM Fastener Torque Chart (Metric)

VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY																UNPLATED CAP SCREWS			
SAE GRADE 5 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS																UNBRAKO 1960 SERIES SOCKET HEAD			
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	TORQUE				CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE					
				DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH				
		IN	SQ. IN.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m				
4	40	0.1120	0.00604	.8	.8	—	—	380	1.4	1.0	—	—	—	—	—				
	48		0.00661	1.0	.8	—	—	420	1.5	1.0	—	—	—	—	—				
6	32	0.1380	0.00909	1.8	1.4	—	—	580	2.6	2.0	—	—	—	—	—				
	40		0.01015	2.0	1.6	—	—	610	2.8	2.2	—	—	—	—	—				
8	32	0.1640	0.01400	3.4	2.4	—	—	900	4.6	3.4	—	—	—	—	—				
	36		0.01474	3.4	2.6	—	—	940	5	3.6	—	—	—	—	—				
10	24	0.1900	0.01750	5	3.6	—	—	1120	7	5	—	—	—	—	—				
	32		0.02000	6	4	—	—	1285	8	6	—	—	—	—	—				
1/4	20	0.2500	0.0318	11	8	—	12	2020	16	12	—	18	3180	18	19				
	28		0.0364	14	10	—	15	2320	19	14	—	21	3640	19	20				
		IN	SQ. IN.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m				
5/16	18	0.3125	0.0524	23	18	22	26	4720	34	24	30	41	5240	34	38				
	24		0.0580	26	19	23	28	5220	34	27	34	41	5800	37	41				
3/8	16	0.3750	0.0775	41	31	38	47	7000	61	47	54	68	7750	61	68				
	24		0.0878	47	34	43	54	7900	68	47	61	75	8780	68	75				
7/16	14	0.4375	0.1063	68	47	61	75	9550	95	75	85	108	10630	95	104				
	20		0.1187	75	54	68	81	10700	108	81	95	122	11870	102	111				
1/2	13	0.5000	0.1419	102	75	92	115	12750	149	108	130	163	14190	149	163				
	20		0.1599	122	88	108	136	14400	163	122	146	183	15990	156	172				
9/16	12	0.5625	0.1820	149	108	133	163	16400	203	149	188	224	18200	210	230				
	18		0.2030	163	122	148	183	18250	230	176	209	258	20300	224	247				
5/8	11	0.6250	0.2260	203	149	183	224	20350	298	230	244	325	22600	285	313				
	18		0.2560	230	176	207	258	23000	325	244	277	359	25600	298	328				
3/4	10	0.7500	0.3340	353	271	325	386	30100	515	380	408	569	33400	495	542				
	16		0.3730	407	298	363	447	33600	569	434	456	630	37300	542	597				
7/8	9	0.8750	0.4620	583	434	523	644	41600	813	624	658	895	46200	793	874				
	14		0.5090	637	475	576	705	45800	895	678	724	983	50900	861	949				
1	8	1.0000	0.6060	868	651	785	915	51500	1220	922	931	1342	60600	1173	1288				
	12		0.6630	949	719	858	997	59700	1356	1003	1079	1491	66300	1241	1356				
1-1/8	7	1.1250	0.7630	1085	813	968	1139	68700	1735	1302	1396	1898	76300	1681	1851				
	12		0.8560	1193	895	1087	1254	77000	1952	1464	1566	2135	85600	1871	2061				
1-1/4	7	1.2500	0.9690	1518	1139	1368	1593	87200	2468	1844	1970	2712	96900	2373	2610				
	12		1.0730	1681	1247	1516	1763	96600	2712	2034	2183	2983	107300	2549	2807				
1-3/8	6	1.3750	1.1550	1979	1491	1792	2068	104000	3227	2413	2586	3559	115500	3145	3457				
	12		1.3150	2278	1708	2042	2373	118100	3688	2766	2935	4067	131500	3308	3640				
1-1/2	6	1.5000	1.4050	2630	1979	2379	2745	126500	4284	3200	3430	4711	140500	4122	4535				
	12		1.5800	2983	2224	2676	3118	142200	4827	3606	3856	5322	158000	4433	4881				



SAE GRADE 5



SAE GRADE 8

Note: These torque values do not apply to cadmium plated fasteners.

Note: These torque values do not apply to cadmium plated fasteners.



SAE GRADE 5



SAE GRADE 8



2.2.3 Metric Fastener Torque Chart

VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY												
SIZE	PITCH	TENSILE STRESS AREA	CLASS 8.8 METRIC BOLTS & CLASS 8 METRIC NUTS					CLASS 10.9 METRIC BOLTS & CLASS 10 METRIC NUTS				
			CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE			
				DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271
		sq. mm	KN	N, m	N, m	N, m	N, m	KN	N, m	N, m	N, m	N, m
3	.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13	1.9	1.4	1.5	2.1
3.5	.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22	3.0	2.2	2.4	3.3
4	.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47	4.4	3.3	3.5	4.8
5	.8	14.2	6.18	6.2	4.6	5.6	6.8	8.85	8.9	6.6	7.1	9.7
6	1	20.1	8.74	11	7.9	9.4	12	12.5	15	11	12	17
7	1	28.9	12.6	18	13	16	19	18	25	19	20	28
8	1.25	36.6	15.9	25	19	23	28	22.8	37	27	29	40
10	1.5	58.0	25.2	50	38	45	55	36.1	72	54	58	79
12	1.75	84.3	36.7	88	66	79	97	52.5	126	95	101	139
14	2	115	50.0	140	105	126	154	71.6	200	150	160	220
16	2	157	68.3	219	164	197	241	97.8	313	235	250	344
18	2.5	192	83.5	301	226	271	331	119.5	430	323	344	473
20	2.5	245	106.5	426	320	383	469	152.5	610	458	488	671
22	2.5	303	132.0	581	436	523	639	189.0	832	624	665	915
24	3	353	153.5	737	553	663	811	220.0	1060	792	845	1170
27	3	459	199.5	1080	810	970	1130	286.0	1540	1160	1240	1690
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2100	1570	1680	2310
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2600	2140	2280	2860
36	4	817	355.0	2560	1920	2300	2690	509.0	3660	2750	2930	4020
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5860	4400	4690	6440
Note: These torque values do not apply to cadmium plated fasteners. <div> 8.8 METRIC CLASS 8.8 </div> <div> 10.9 METRIC CLASS 10.9 </div>												



General Information and Specifications

2.3 SPECIFICATIONS

2.3.1 Travel Speeds

First Gear	5 km/h (3.1 mph)
Second Gear	10 km/h (6.2 mph)
Third Gear	25 km/h (15.5 mph)
Fourth Gear (Turbo Only)	35 km/h (21.7 mph)

2.3.2 Hydraulic Cylinder Performance Specifications

Note: Machine with no load, engine at full throttle, hydraulic oil above 130° F (54° C) minimum, engine at operating temperature.

Function	Approximate Times (sec.)				
	7M	8M	9M	12M	13M
Boom Extend	11,60	11,60	13,30	14,03	16,88
Boom Retract	9,83	9,83	11,27	12,48	15,02
Boom Lift	8,28	9,43	14,0	12,32	14,00
Boom Lower	5,63	6,41	9,65	8,49	9,65
Attachment Tilt - UP	9,78	9,78	9,78	9,78	9,78
Attachment Tilt - DOWN	4,50	4,50	4,50	4,50	4,50
Outrigger - UP	N/A	N/A	N/A	2,93	2,93
Outrigger - DOWN	N/A	N/A	N/A	2,19	2,19
Sway	11,0	11,0	11,0	11,0	11,0

2.3.3 Electrical System

Note: Refer to Section 9.4, "Fuses and Relays," for more information.

Battery:	
Type, Rating	12V DC, Negative (-) Ground, Limited Maintenance, Wet Charged
Quantity	1 (100 Ah) (C ₂₀)
Reserve Capacity	CCA @ -18° C: 880 EN
Group/Series	DIN 600,38
Alternator	14V, 70 Amps
Starter	12V, 3,0 KW Type EV (Gear Reduction)



2.3.4 Engine Performance Specifications

Note: Engine manufacturer's maximum "high idle" setting is lockwired and sealed. **DO NOT** disturb this setting.

a. Before S/N 1160000358

Description	Naturally Aspirated	Turbo
Engine Make/Model	Perkins 1004-42	Perkins 1004-40T
Low Idle	925 RPM \pm 50 RPM	925 RPM \pm 50 RPM
High Idle	2340 RPM \pm 50 RPM	2340 RPM \pm 50 RPM
Horsepower	80,4 BHP/60 KW @ 2200 rpm	99,9 BHP/74,5 KW @ 2200 rpm
Fuel Delivery	Fuel Injection	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

b. S/N 1160000358 & After

Description	Naturally Aspirated	Turbo
Engine Make/Model	Perkins 1104C-44	Perkins - 1004-40T
Low Idle	925 RPM \pm 50 RPM	925 RPM \pm 50 RPM
High Idle	2340 RPM \pm 50 RPM	2340 RPM \pm 50 RPM
Horsepower	80,4 BHP/60 KW @ 2200 rpm	99,9 BHP/74,5 KW @ 2200 rpm
Fuel Delivery	Fuel Injection	Fuel Injection
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	Dry Type, Replaceable Primary and Safety Elements

2.3.5 Tires

Note: Standard wheel lug nut torque is 500 Nm (369 lb-ft).

a. 7M, 8M & 9M

Description	Tire Air Pressure
16/70-20 MPT04 CONST	3,5 Bar (50 psi)
405/70-20 MPT01 AG	3,5 Bar (50 psi)
405/70-24 MPT01 AG	4,0 Bar (58 psi)
405/70-24 MPT04 CONST	4,0 Bar (58 psi)

b. 12M & 13M

Description	Tire Air Pressure
405/70-24 MPT01 AG	4,0 Bar (58 psi)
405/70-24 MPT04 CONST	4,0 Bar (58 psi)



General Information and Specifications

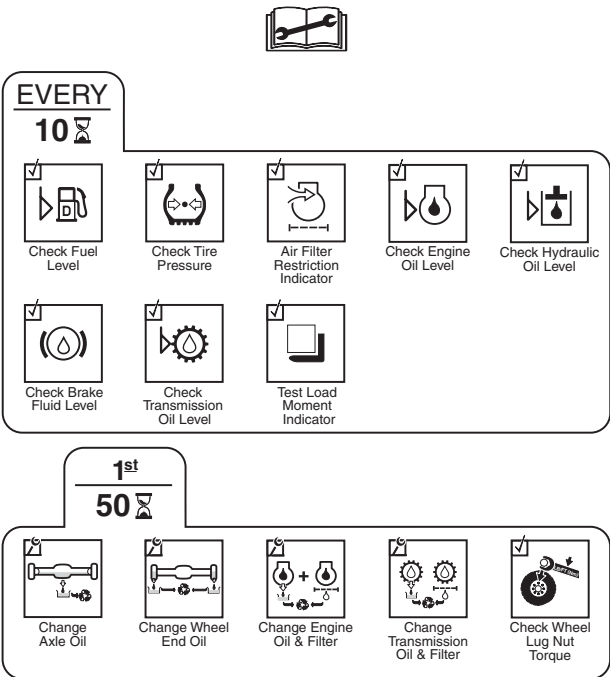
2.4 FLUIDS, LUBRICANTS AND CAPACITIES

Engine Crankcase Oil	
Capacity w/Filter Change	8,5 liters (9 quarts)
Oil Type	15W-40 CE
Fuel Tank	
Capacity	140 liters (37 gallons)
Type of Fuel	U.S.A. #2 Diesel
Cooling System	
System Capacity	19,7 liters (20.8 quarts)
Type of Fluid	50/50 mix of ethylene glycol & water
Axles	
Differential Housing Capacity - Front	7,3 liters (7.8 quarts)
Wheel End Capacity	1,4 liters (1.5 quarts)
Type of Fluid	Mobilfluid 424® (ISO 46)
Hydraulic System	
System Capacity	246 liters (65 gallons)
Reservoir Capacity to FULL Mark	160 liters (42.3 gallons)
Type of Fluid	Mobilfluid 424® (ISO 46)



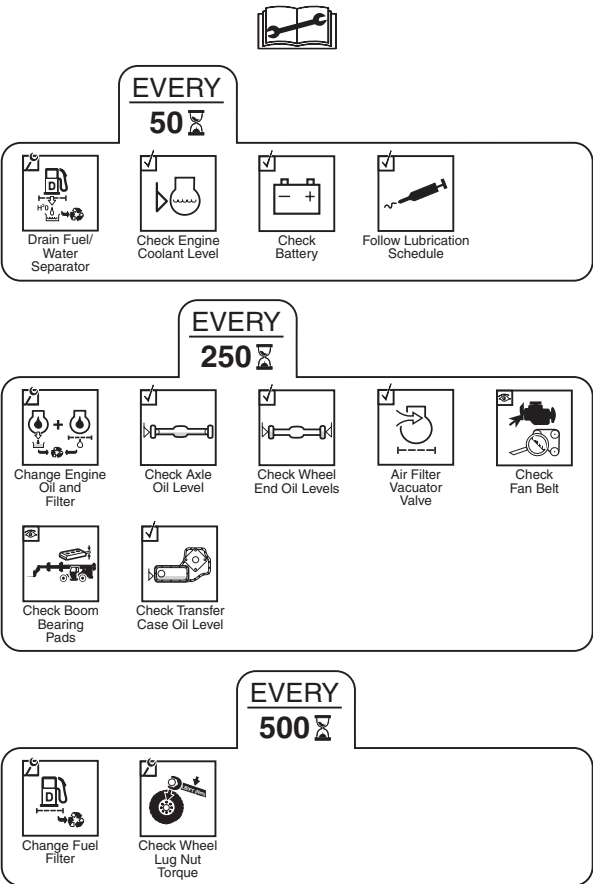
2.5 MAINTENANCE SCHEDULES

2.5.1 8 & 1st 50 Hour Maintenance Schedule



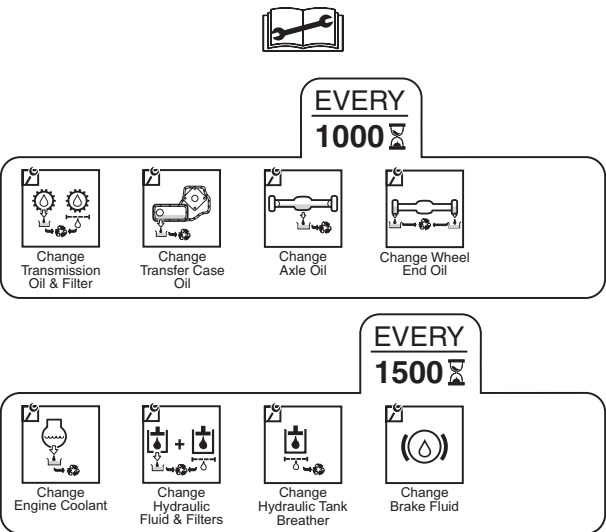
MZ1670

2.5.2 50, 250 & 500 Hour Maintenance Schedule



MZ1680

2.5.3 1000 & 1500 Hour Maintenance Schedule



MZ1690



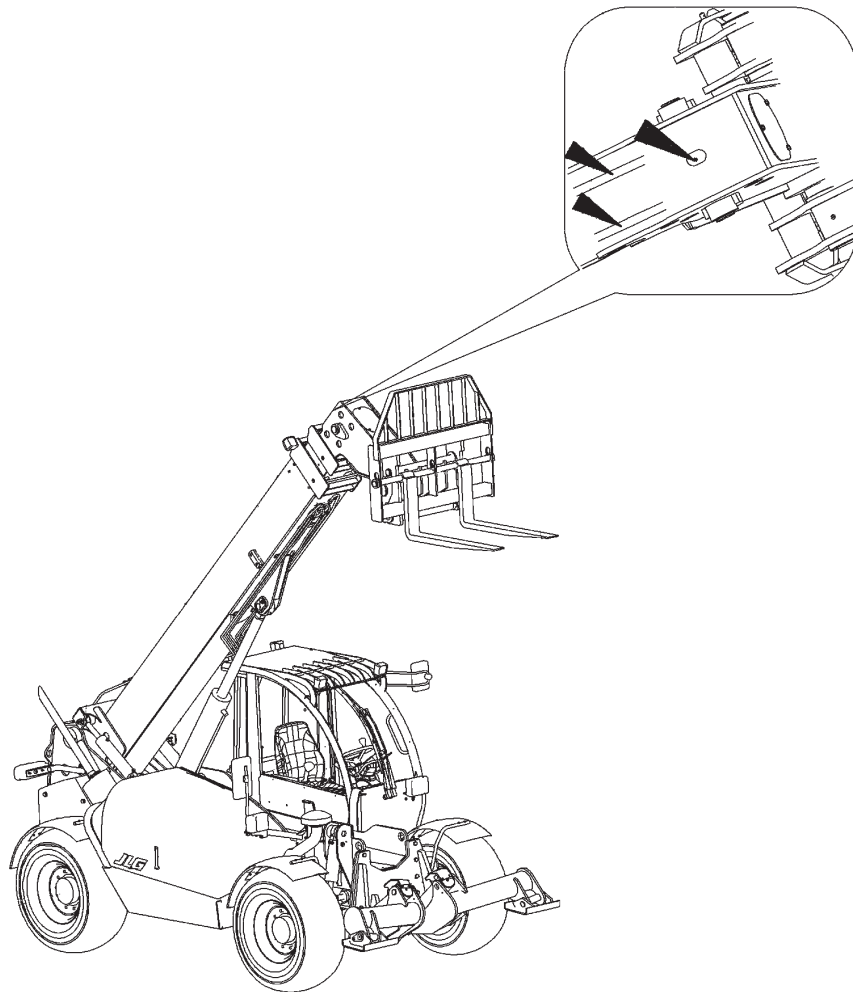
2.6 LUBRICATION SCHEDULES

2.6.1 8 Hour Lubrication Schedule

EVERY

8 

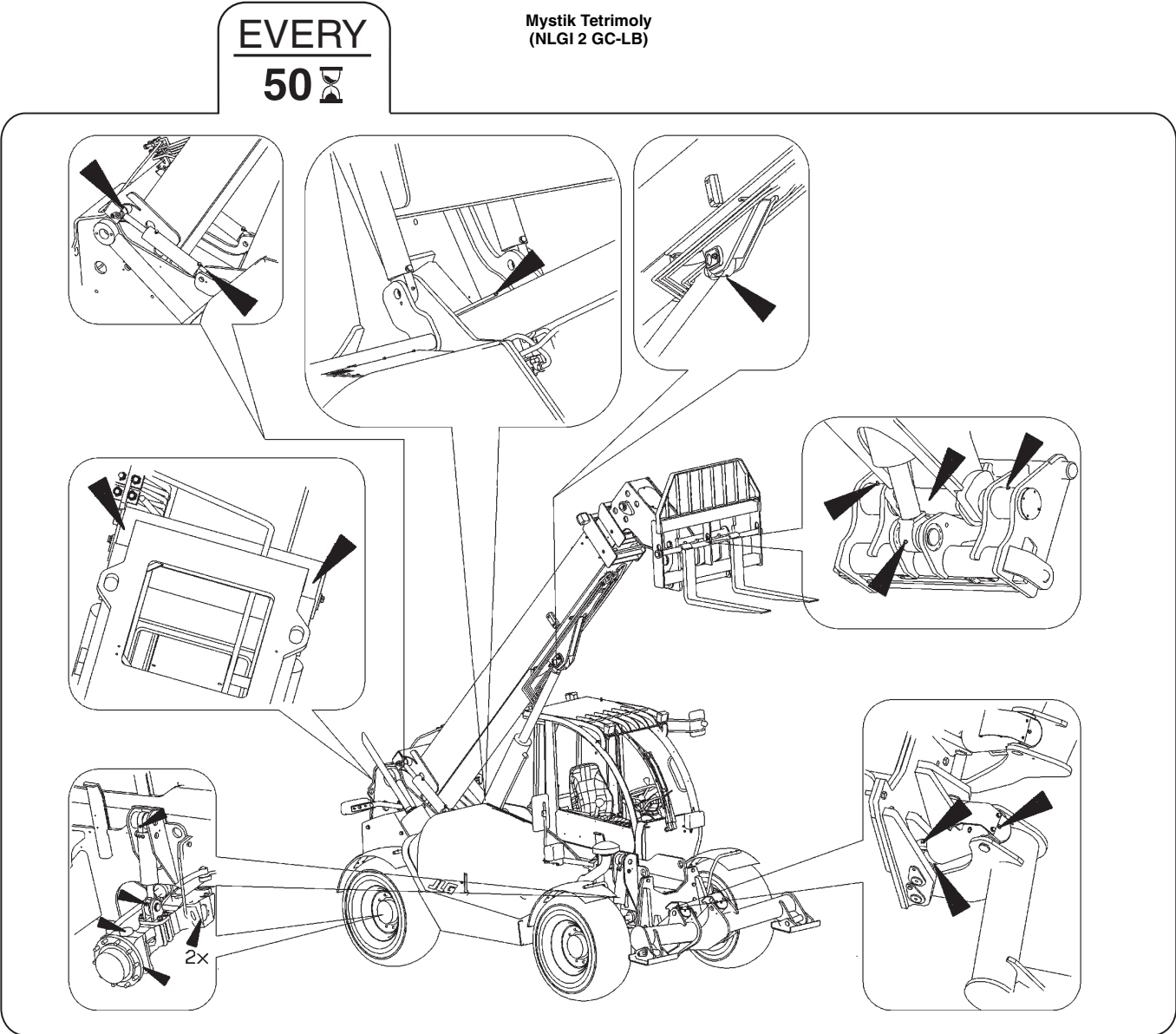
Mystik Tetrimoly
(NLGI 2 GC-LB)



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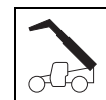
2.6.2 50 Hour Lubrication Schedule



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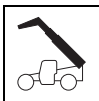
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Section 3 Boom

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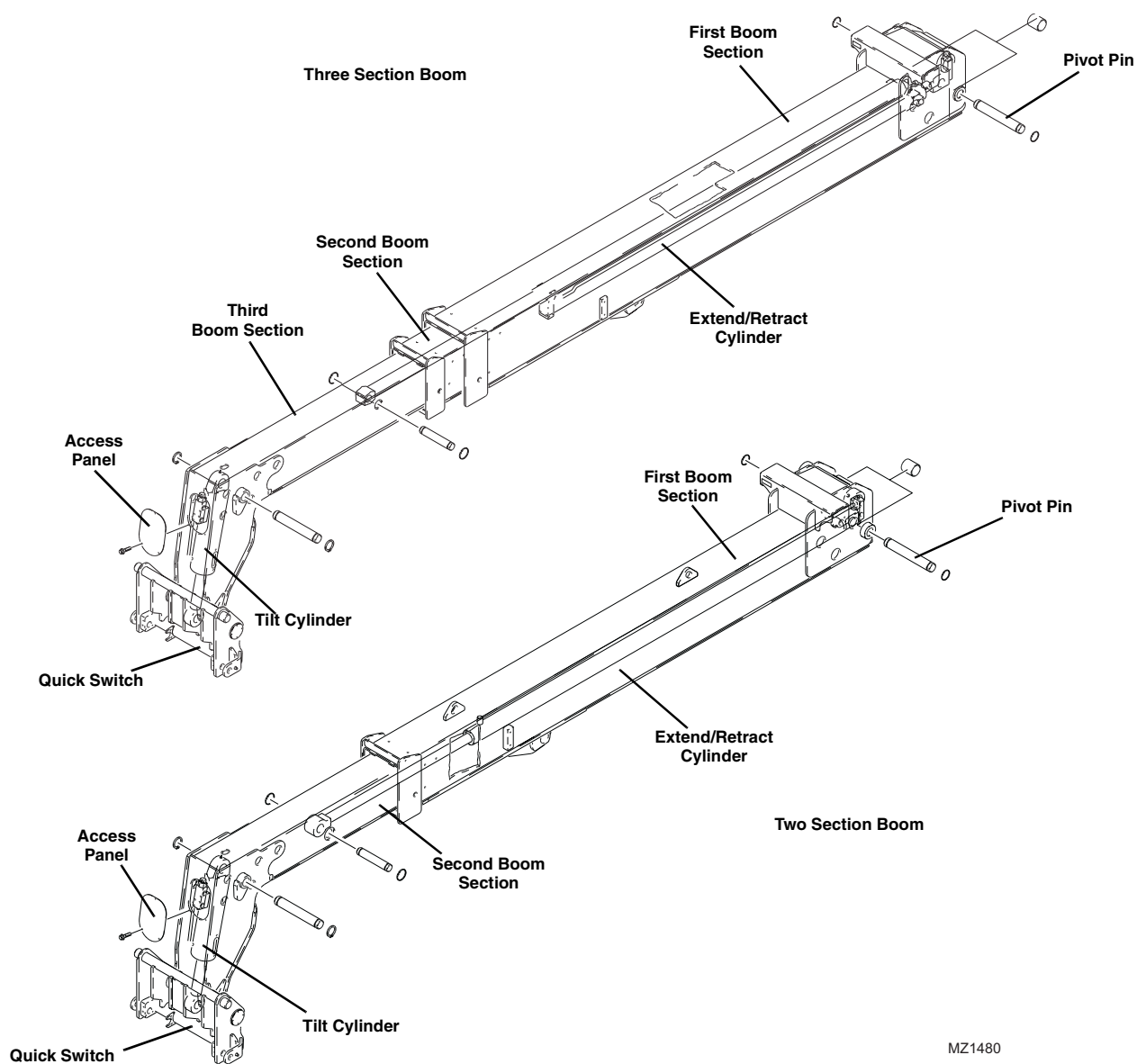
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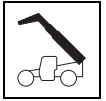
Boom

3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the boom system. The following illustration identifies the components that are referred to throughout this section.



MZ1480



3.2 BOOM SYSTEM

3.2.1 Boom System Description

The boom operates via an interchange among the electrical, hydraulic and mechanical systems. Components involved include the joystick, tilt cylinder, extend/retract cylinder, lift/lower cylinder, compensation cylinder, electronic sensors, various pivots, supporting hardware and other components.

3.3 BOOM ASSEMBLY MAINTENANCE

IMPORTANT: Boom replacement must be completed in sequence, one boom section at a time, as described in these instructions.

Before beginning, conduct a visual inspection of the machine and work area, and review the task about to be undertaken. Read, understand and follow these instructions.

3.3.1 Boom Removal

1. Remove any attachment from the quick switch assembly. Refer to Section 3.5.1, "Connecting with a Mechanical Quick Switch Device."

Note: If replacing the innermost boom section, remove the quick switch assembly. Refer to Section 3.5.4, "Quick Switch Removal."

2. Park the machine on a hard, level surface. Be sure there is enough room in front of the machine to allow the boom sections to be removed.
3. Fully retract the boom then raise the boom to access the rod end pin of the lift/lower cylinder. Place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
4. Place a Do Not Operate Tag on both the ignition key switch and steering wheel stating that the machine should not be operated.
5. Open the engine cover. Allow the system fluids to cool.
6. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
7. Relieve any trapped pressure in the tilt hydraulic system by using the handle or wrench (located in the toolbox) and move the double nut on the side of the actuator module on the tilt valve section back and forth. Repeat on the auxiliary valve section and on the extend/retract section.
8. Label, disconnect and cap hydraulic hoses attached the hose rack at the left rear corner of the boom.
9. Disconnect the boom angle indicator rod from the switch at the inside left corner of the main boom section and frame. Refer to Section 9.12.8, "Boom Angle Sensor."
10. Support the front of the boom by placing a sling behind the boom head. Support the lift/lower cylinder and remove the lock bolt and then the rod end pin. Lower the lift/lower cylinder onto the frame rails.
11. Lower the boom to a level position and place a suitable support under the boom head. Reposition the slings to each end of the boom.
12. Remove the lock bolt and pin from the compensation cylinder on each side of the first boom section. Remove the lock bolt and pivot pin from rear of first boom section.
13. Lift the complete boom off machine and set on level ground or supports being careful not to damage the tubes on the side of the first boom section.



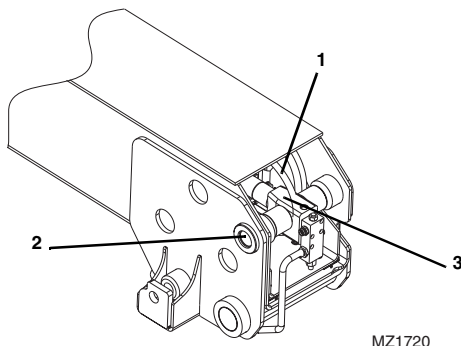
Boom

a. If the boom is going to be disassembled after removal:

1. Set the complete boom on level ground and by repositioning the slings, turn boom over on to the top side. Set the complete boom on suitable stands to begin teardown.

Note: With the complete boom setting upside down, the other boom section(s), tilt cylinder and hoses are made more accessible.

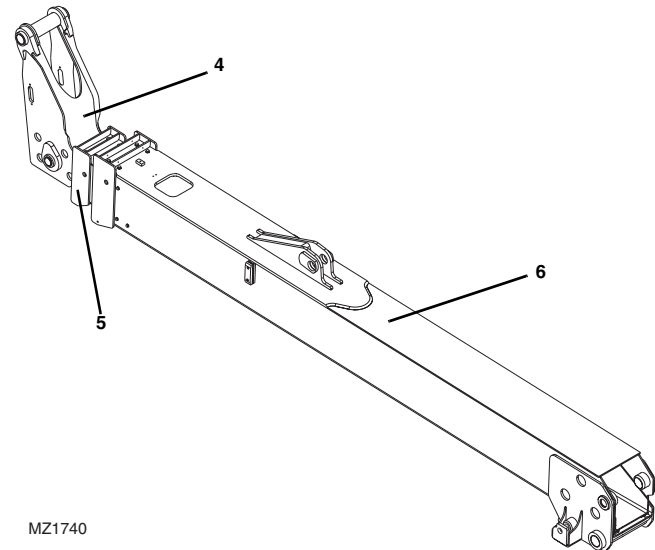
2. Remove the access panel from the boom head.
3. Label, disconnect and cap the hoses attached to the tilt cylinder and the hose rack on the side of the first boom section.
4. Attach a sling through the rod end of the tilt cylinder. Remove the clip from the barrel end of the tilt cylinder pin. Remove the tilt cylinder pin and lift the tilt cylinder out of the boom head.
5. Remove the hose clamp inside the innermost boom section.
6. Label, disconnect and cap the hoses attached to the extend/retract cylinder at the rear of the boom.
7. Pull the extend/retract, tilt and auxiliary hoses (1) out through the rear of the boom.
8. Remove the clip from the rear extend/retract cylinder pin (2).
9. On 12 & 13M machines, remove the 2 brackets that secure the extend/retract cylinder to the second boom section.
10. Use a sling around the innermost boom section to take any pressure off of the wear pads to make pad removal easier.
11. Use a sling to pull the remaining boom section(s) out far enough to gain access to the rod end of the extend/retract cylinder.
12. Remove the clip from the front extend/retract cylinder pin. Pull the extend/retract cylinder (3) out through the rear of the boom.



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3.3.2 Second Section Boom Removal (12 & 13M)

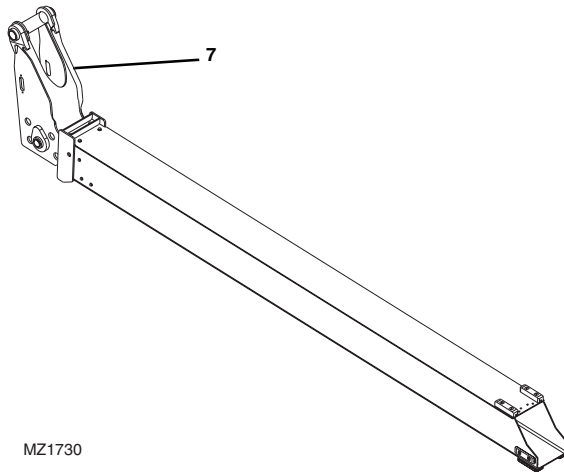
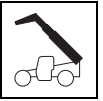
1. With the boom sections sitting on suitable supports, use a sling around the third boom section (4) to take any pressure off of wear pads to make pad removal easier.
2. Remove the top, left and right side wear pads, backing plates and shims. Loosen the bottom wear pad bolts and remove the shims from the first boom section to gain the necessary clearance to remove the first boom section from the second boom section (5). Tag each pad, backing plate, shim and bolts from each location.
3. Pull the second and third boom sections out from the first boom section (6).



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3.3.3 Third Section Boom Removal (12 & 13M) Second Section Boom Removal (7, 8 & 9M)

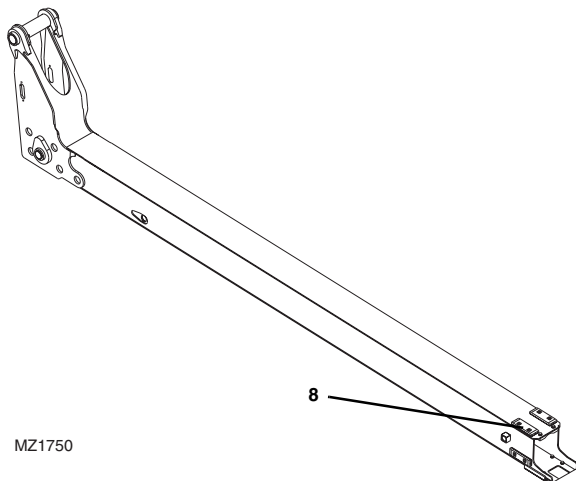
1. Remove the top left and right side wear pads, backing plates and shims. Loosen the bottom wear pad bolts and remove the shims from the innermost boom section to gain the necessary clearance to remove the last boom section (7). Tag each pad, backing plate, shim and bolts from each location.
2. Pull out the innermost boom section (7).
3. Remove the remaining wear pads.



MZ1730

3.3.4 Third Section Boom Installation (12 & 13M) Second Section Boom Installation (7, 8 & 9M)

1. Install the bottom rear wear pads (8) and bolts onto the innermost boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Install the bottom rear left and right side wear pads, backing plate and bolts (do not shim or tighten bolts). Install top rear wear pads, backing plates and bolts (do not shim or tighten bolts).



MZ1750

2. Grease the inside of the next boom section on areas where the innermost boom section wear pads will slide.
3. Using a suitable sling, balance the innermost boom section and carefully slide 1 m to 1,5 m (3' to 4') into the front of the next boom section. Set the innermost boom section head onto suitable supports and reset

sling under the boom head. Carefully slide the innermost boom section into the next section. Leave 15 cm to 20 cm (6" to 8") of the innermost boom section out to be able to install wear pads on the front of the next boom section.

4. With the boom head still supported, install the top wear pads, washers and bolts in the front of the larger boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Remove the boom head from supports and install the bottom wear pads, backing plates, shims and bolts in the front of the larger boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Install both left and right side front wear pads, backing plates, shims and bolts in the front of the larger boom section. Apply Loctite® #242 and torque to 50 Nm (37 lb-ft).

Note: Shim ALL side wear pads as needed to maintain a minimum gap in the horizontal direction or a tight fit. The number of shims can vary at each shim point except on the bottom wear pads.

IMPORTANT: Light lubrication of the boom wear surfaces with a factory authorized grease is recommended to keep the boom wear surfaces lubricated properly.

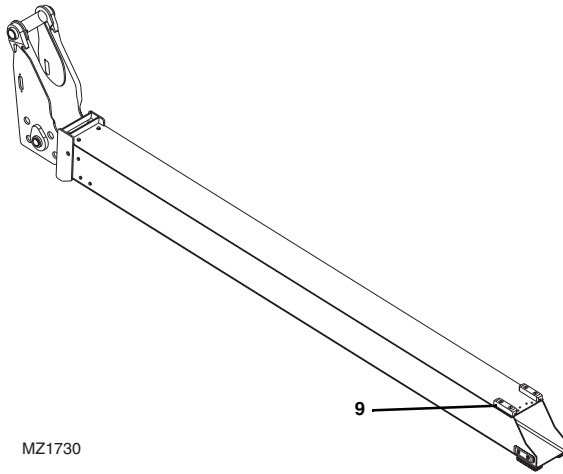
5. Tighten all wear pads after ensuring the minimum gap requirements have been met. Refer to Section 3.4.1, "Wear Pad Inspection."

3.3.5 Second Section Boom Installation (12 & 13M)

1. Install the bottom rear wear pads (9) and bolts onto the second boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Install the bottom rear left and right side wear pads, backing plate and bolts (do not shim or tighten bolts). Install top rear wear pads, backing plates and bolts (do not shim or tighten bolts).
2. Grease the inside of the first boom section on areas where the third boom section wear pads will slide.
3. Using a suitable sling, balance the first and second boom sections and carefully slide 1 m to 1,5 m (3' to 4') into the front of the third boom section. Set the third boom section head onto suitable supports and reset sling under the boom head. Carefully slide the first and second boom sections into the first section. Leave 15 cm to 20 cm (6" to 8") of the second boom section out to be able to install wear pads on the front of the first boom section.



Boom



MZ1730

4. With the boom head still supported, install the top wear pads, washers and bolts in the front of the first boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Remove the boom head from supports and install the bottom wear pads, backing plates, shims and bolts in the front of the first boom section. Apply Loctite® #242 and torque to 90 Nm (66 lb-ft). Install both left and right side front wear pads, backing plates, shims and bolts in the front of the first boom section. Apply Loctite® #242 and torque to 50 Nm (37 lb-ft).

Note: Shim ALL side wear pads as needed to maintain a minimum gap in the horizontal direction or a tight fit. The number of shims can vary at each shim point except on the bottom wear pads.

IMPORTANT: Light lubrication of the boom wear surfaces with a factory authorized grease is recommended to keep the boom wear surfaces lubricated properly.

5. Tighten all wear pads after ensuring the minimum gap requirements have been met. Refer to Section 3.4.1, "Wear Pad Inspection."

3.3.6 Boom Installation

1. Insert the extend/retract cylinder through the rear of the boom. Align the extend/retract rod end with the cylinder pin mounting hole on the last boom section. Install the extend/retract cylinder pin and retaining clip.

IMPORTANT: On 12 & 13M machines, install the two brackets the secure the extend/retract cylinder to the second boom section.

2. Align the extend/retract barrel end with the cylinder pin mounting hole on the first boom section. Install the extend/retract cylinder pin and retaining clip.

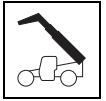
Note: Grease extend/retract cylinder barrel end bore and pin before installing.

3. Attach a sling through the rod end of the tilt cylinder and position the cylinder to its original mounting location. Install the tilt cylinder pins and retaining clips.
4. Insert the extend/retract, tilt and auxiliary hoses through the boom.
5. Uncap and connect the previously labeled hydraulic hoses to the appropriate locations on each cylinder.
6. Install the hose clamps inside the innermost boom section.
7. Using suitable slings, turn the boom over to its original orientation.
8. Rebalance the boom assembly with slings, lift and carefully guide the boom into place. Align the frame pivot bore with the boom pivot bore. Install the boom pivot pin. Apply Loctite® #242 and torque to 300 Nm (221 lb-ft).
9. With the sling still in place, install both compensation cylinders, pins and lock bolts. Apply Loctite® #242 and torque to 120 Nm (88 lb-ft).
10. With the sling still in place, raise the boom enough to install the lift/lower pin and lock bolt. Apply Loctite® #242 and torque to 300 Nm (221 lb-ft).

Note: Raising the boom up or down with the sling maybe necessary so the boom, compensation and lift/lower cylinder bores can be aligned for easier pin installation.

Note: Grease the boom pivot bore, compensation cylinder rod ends, lift/lower rod end and pins before installing.

11. Uncap and connect the previously labeled hydraulic hoses to the hose rack on the side of the first boom section.
12. Connect the boom angle indicator rod from switch at the inside left rear corner of the main boom section and frame. Refer to Section 9.12.8, "Boom Angle Sensor," for adjustment information.
13. Connect the battery negative (-) cable to the battery negative (-) terminal.
14. Start the engine and operate all boom functions several times. Check for leaks, and check the hydraulic fluid level in the reservoir; add fluid if required.
15. Install the access panel on the boom head.
16. Close and secure the engine cover.



3.4 BOOM WEAR PADS

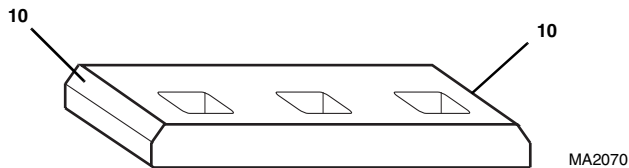
The wear pads on this machine are flat rectangular wear pads with metal inserts.

A total of 13 wear pads are installed on the boom sections of the 7, 8 & 9M machines.

A total of 26 wear pads are installed on the boom sections of the 12 & 13M machines.

3.4.1 Wear Pad Inspection

Inspect all wear pads for wear. If the angle indicators (10) on the ends of the wear pads are visible, the wear pads can be reused. If the pads show uneven wear (front to back), they should be replaced. Replace pads as a set if worn or damaged.

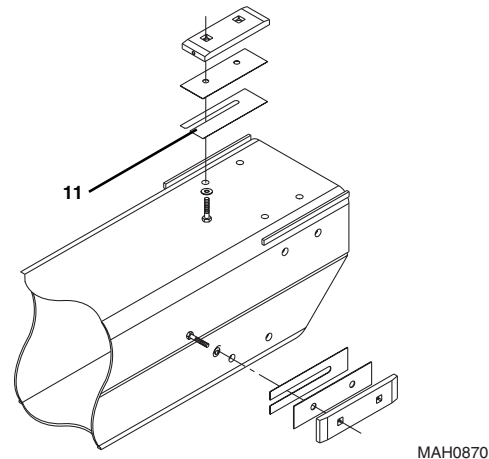


3.4.2 Boom Wear Pad Replacement

When replacing a wear pad on the boom, replace both wear pads on that side of the boom; e.g.: replace top front left and top front right wear pads at the same time.

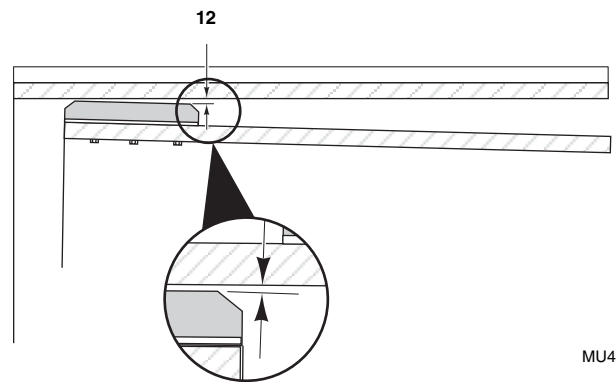
Usually, shimming will remain the same when installing new wear pads. All wear pads are secured to the boom using different capscrews and washers. When installing new wear pads, apply Loctite® #242 to all wear pad mounting capscrews. Torque right and left side wear pads to 50 Nm (36 lb-ft) and torque top and bottom side wear pads to 90 Nm (66 lb-ft). Grease the new pads and surrounding area.

Note: The first shim next to a wear pad always needs to have the two hole configuration. The remaining pads (11) may have the large slot configuration.



Use shims (11) under the wear pads as required to maintain a maximum gap of 1,5 mm (0.06") (12) between the wear pad on the front and sides of the boom. The gap at the rear of the boom should be no more than 3 mm (0.12").

Shims are available in four thicknesses, 0,5mm (0.02"), 1 mm (0.04"), 1,5mm (0.06") and 2,0mm (0.08").



3.4.3 Boom Wear Pad Lubrication

After replacing any wear pad(s), or after prolonged periods of inoperation, light lubrication of the boom wear surfaces with a factory authorized grease is recommended to keep the boom wear surfaces lubricated properly. Light lubrication of the boom wear surfaces is also recommended when the machine is stored, to help prevent rusting.



Boom

3.5 QUICK SWITCH ASSEMBLY

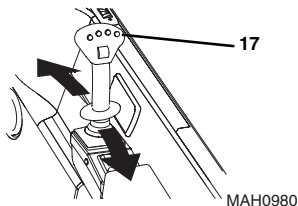
This machine is equipped with a quick switch system for easy attachment changes.

3.5.1 Connecting with a Mechanical Quick Switch Device

1. Retract quick switch device to provide clearance. Check to be sure lock pin (13) and retainer pin (14) is out.
2. Align attachment pin (15) with recess in attachment (16). Raise boom slightly to engage attachment pin in recess.
3. Engage quick switch device.
4. Shut off engine. Exit cab and insert lock pin and secure with retainer pin.
5. If attachment is equipped, connect auxiliary hydraulic hoses. See Section 3.5.3, "Connecting with a Quick Switch to a Hydraulic Operated Attachment."

3.5.2 Connecting with a Hydraulic Quick Switch Device

1. Retract quick switch device to provide clearance. Check to be sure lock pin is disengaged.
2. Align attachment pin (15) with recess in attachment (16). Raise boom slightly to engage attachment pin in recess.
3. Engage quick switch device.
4. Press the button (17) and at the same time, move the joystick to engage or to disengage the quick switch device.



5. Raise the boom to eye level and visually check that the quick switch pin protrudes through the hole. If the pin does not protrude through the hole, place the attachment on the ground and return to step 2.
6. If attachment is equipped, connect auxiliary hydraulic hoses. See Section 3.5.3, "Connecting with a Quick Switch to a Hydraulic Operated Attachment."

3.5.3 Connecting with a Quick Switch to a Hydraulic Operated Attachment

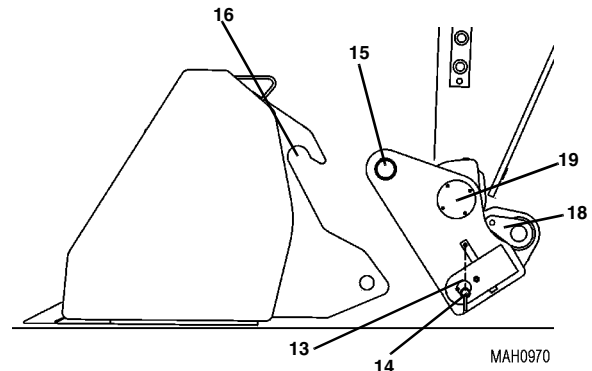
1. Lower attachment to ground. Set parking brake, shut off engine and turn key back to the "ON" position.
2. Relieve pressure in the hydraulic system by actuating the joystick.
3. Connect the quick-disconnect fittings.
4. Start the engine.

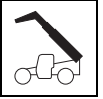
3.5.4 Quick Switch Removal

1. Support the quick switch assembly. Remove the lock bolt (18) holding the tilt cylinder rod end to the quick switch assembly. Remove the tilt cylinder pin.
2. Support the quick switch assembly. Remove the four bolts and covers (19) from each end of the quick switch assembly. Remove the pin from the quick switch assembly from either side.
3. Inspect the above pin for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired, the pin must be replaced.

3.5.5 Quick Switch Installation

1. Assemble the quick switch to the boom head. Line up the quick switch between the mounts on the boom head. The quick switch should be centered in the boom head.
2. Coat the quick switch pivot pin with an anti-seize compound. Insert the quick switch pivot pin through the quick switch and boom head. Replace the end covers and four bolts (19) to each end of the quick switch.
3. Align the quick switch with the tilt cylinder rod end and insert the tilt cylinder pin. Align the tilt cylinder pin and screw in the locking bolt (18). Torque as required.

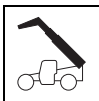




3.6 TROUBLESHOOTING

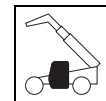
This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Problem	Cause	Remedy
1. Boom will not extend or retract	<ol style="list-style-type: none"> 1. Broken hydraulic hose(s) or tube(s) and/or connections leaking. 2. Extend/retract hydraulic system not operating properly. 3. Faulty extend/retract cylinder. 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8, "Hydraulic System." 3. Repair cylinder. Refer to Section 8.9.4, "Cylinder Inspection."
2. Boom will not fully extend.	<ol style="list-style-type: none"> 1. Extend/retract hydraulic system not operating properly. 	<ol style="list-style-type: none"> 1. Refer to Section 8, "Hydraulic System."
3. Boom shifts to right or left when extending.	<ol style="list-style-type: none"> 1. Boom side wear pads improperly shimmed or worn. 	<ol style="list-style-type: none"> 1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.4.2, "Boom Wear Pad Replacement."
4. Excessive pivot pin noise and/or wear.	<ol style="list-style-type: none"> 1. Insufficient lubrication. 2. Worn bearing(s). 	<ol style="list-style-type: none"> 1. Lubricate at regular intervals. Refer to Section 2.6, "Lubrication Schedules." Replace worn pins as needed. 2. Replace bearing(s) and lubricate at regular intervals. Refer to Section 2.6, "Lubrication Schedules."
5. Boom will not raise or lower.	<ol style="list-style-type: none"> 1. Broken hydraulic hoses or tubes and/or connection leaks. 2. Lift/lower hydraulic system not operating properly. 3. Faulty lift/lower cylinder. 4. Seized boom pivot pin bearing. 	<ol style="list-style-type: none"> 1. Locate break, replace hose(s) or tube(s), tighten connections. 2. Refer to Section 8, "Hydraulic System." 3. Repair cylinder. Refer to Section 8.9.4, "Cylinder Inspection." 4. Replace bearing.



Boom

Problem	Cause	Remedy
6. Rapid boom pad wear.	<ol style="list-style-type: none">1. Incorrect wear pad gap.2. Rapid cycle times with heavy loads.3. Contaminated, corroded or rusted wear pad sliding surfaces.4. Operating in extremely dusty/abrasive conditions.	<ol style="list-style-type: none">1. Check wear pad gaps and correct as needed. Refer to Section 3.4.2, "Boom Wear Pad Replacement."2. Reduce cycle times.3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).4. Clean equipment frequently.
7. Auxiliary hydraulics will not operate.	<ol style="list-style-type: none">1. Auxiliary hydraulic system not operating properly.	<ol style="list-style-type: none">1. Refer to Section 8, "Hydraulic System."

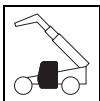


Section 4

Cab and Covers

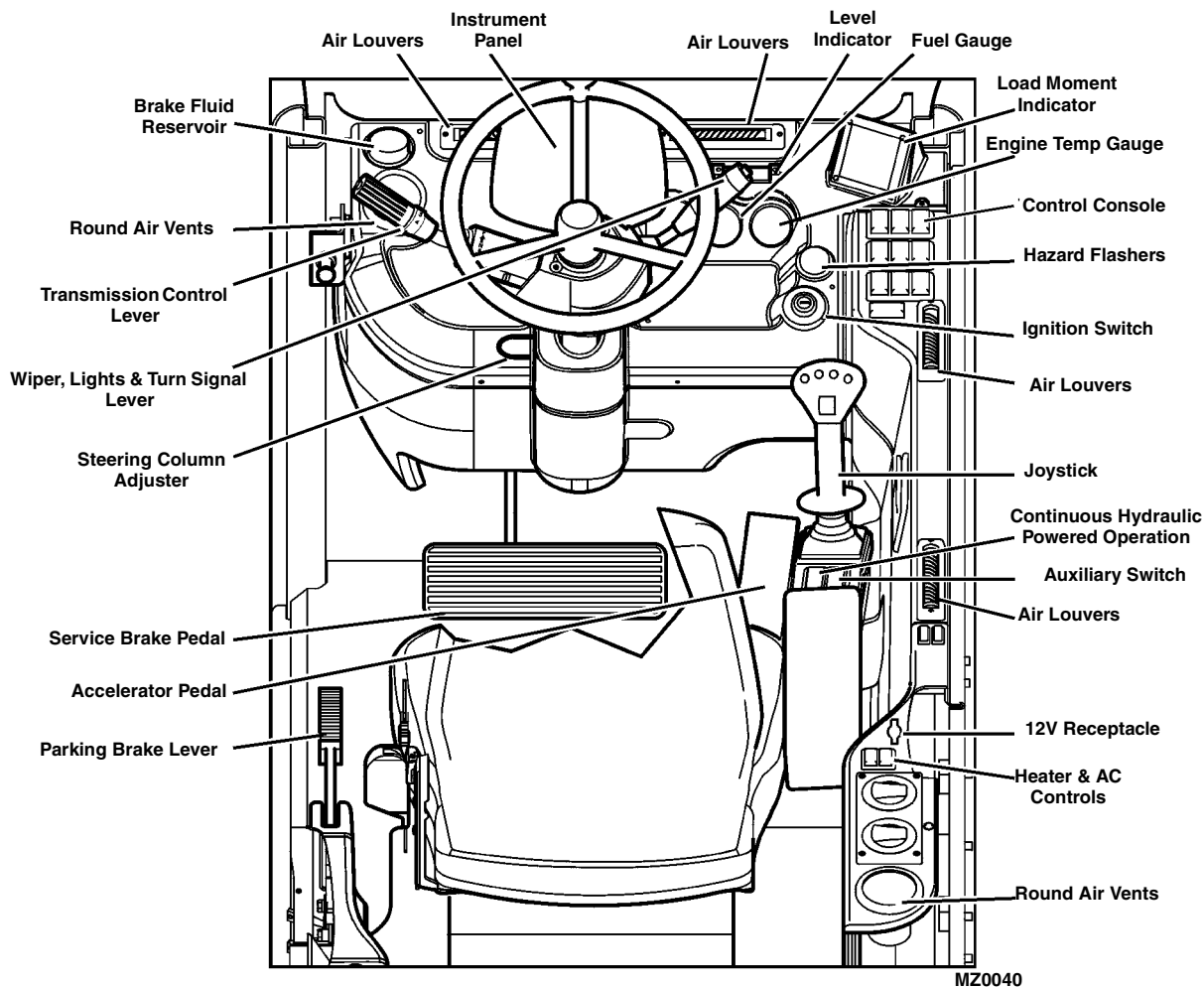
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4.1 OPERATOR'S CAB AND COVERS COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the machine cab and covers. The following illustration identifies the components that are referred to throughout this section.





WARNING: DO NOT service the machine without following all safety precautions as outlined in the “Safety Practices” section of this manual. Failure to follow the safety practices may result in death or serious injury.

4.2 OPERATOR'S CAB

4.2.1 Serial Number Decal

The cab serial number decal is located inside the cab, below the seat. Information specified on the serial number plate includes the cab model number, the cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.

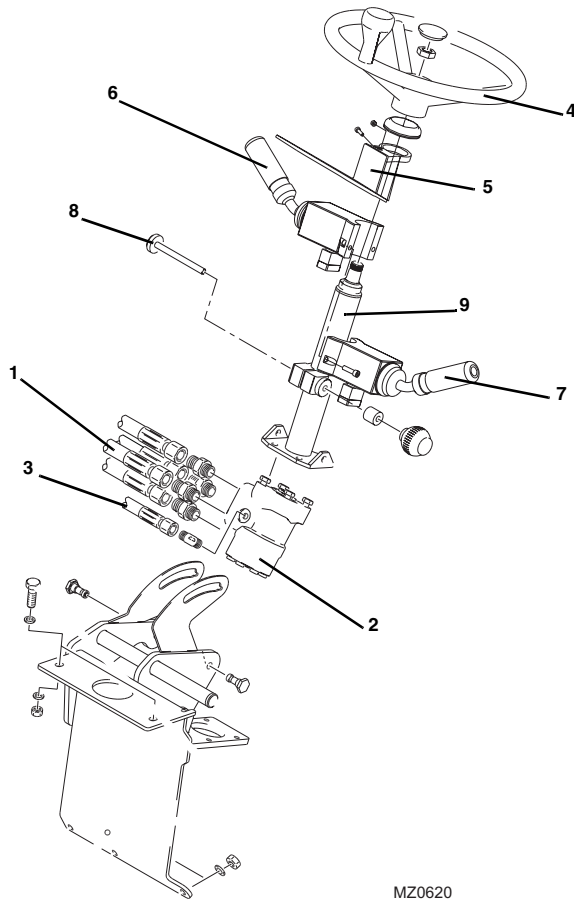
4.3 CAB COMPONENTS

4.3.1 Steering Column and Orbitrol Valve

a. Orbitrol Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the lower dash panel.
6. Label, disconnect and cap the four hoses (1) from the side of the steering valve (2). Cap the fittings on the steering valve. Label, disconnect and plug the load sense hose (3) at the front of the steering valve. Cap the fitting on the steering valve.
7. Remove the steering wheel (4), disconnect and remove the display panel bracket (5), disconnect and remove the accessory lever (6) and transmission control lever (7), loosen and remove the locking bolt (8) for the steering column adjustment, loosen and remove both steering column pivot bolts and nuts.
8. Support the steering valve, and remove the four hex-head capscrews and four lockwashers.
9. Remove the steering assembly (9) through the dash panel opening.

Note: DO NOT disassemble the orbitrol valve. The orbitrol valve is not serviceable and must be replaced in its entirety, if defective.



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b. Orbitrol Valve Installation

1. Secure the steering valve to the steering column with four hex-flange capscrews and four lockwashers. Torque capscrews to 35 Nm (25 lb-ft).
2. Install the steering valve through the dash panel opening. Position steering valve in the cab, with the "LS" port pointing forward (away from the operator).
3. Install both steering column pivot bolts and nuts, install the locking bolt for the steering column adjustment, install the wiper lever and transmission control lever and connect the harness connector, install the steering wheel assembly. Torque the steering wheel nut to 25 Nm (18 lb-ft).

Note: ALWAYS use new o-rings when servicing the machine.

4. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
5. Connect the load sense hose to the "LS" port at the top of the steering valve.

6. Connect the four previously labeled hoses to the appropriate ports.
7. Connect the battery negative (-) cable to the battery negative (-) terminal.
8. Start the engine and check the operation of steering system. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required. Wipe up any spilled oil.
9. Install the lower dash panel.
10. Close and secure the engine cover.

c. Power Steering Test

Conduct a pressure check of the steering hydraulic circuits at the main control valve. Refer to Section 8.4.2, "Adjusting Hydraulic Pressure."

4.3.2 Service Brake Pedal and Valve

a. Service Brake Valve Removal

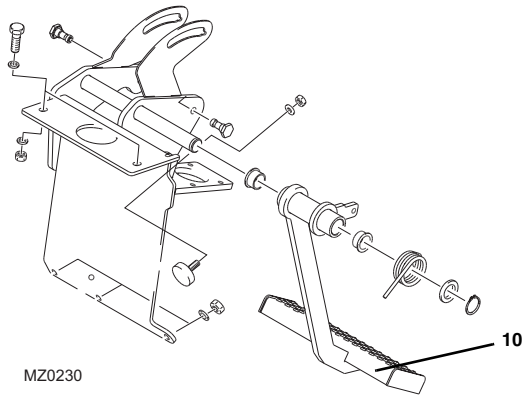
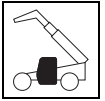
Refer to Section 8.8.2, a. "Service Brake Valve Removal," for removal information.

b. Service Brake Valve Installation

Refer to Section 8.8.2, b. "Service Brake Valve Installation," for installation information.

c. Service Brake Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the lower dash panel.



6. Remove the circlip, flat washer, and the return spring securing the service brake pedal to the cab.
7. Remove the clip/pin from the brake plunger fork link.
8. Remove the service brake pedal (10) from the cab.

d. Service Brake Pedal Installation

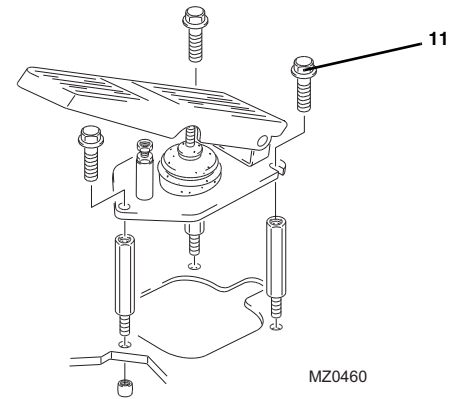
1. Position the service brake pedal in its mounting location within the cab.
2. Install the brake pedal being careful to reposition the brake plunger yoke. Install the return spring, washer and clip. Install clip/pin in brake plunger fork link.
3. Adjust the brake pedal as needed.
4. Install and secure the lower dash cover.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Close and secure the engine cover.

4.3.3 Throttle Pedal Replacement

a. Throttle Pedal Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the three capscrews (11), three lockwashers securing the throttle pedal assembly to the cab floor.

6. Remove the hex jam nut and flat washer securing the throttle cable to the throttle pedal assembly.
7. Remove the clip/pin from the fork link.
8. Remove the throttle pedal assembly from the cab.



b. Throttle Pedal Installation

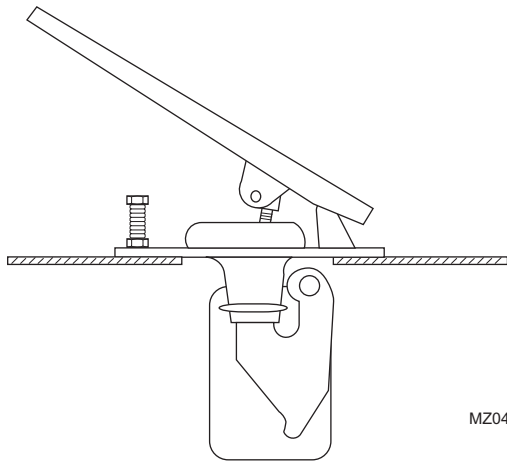
1. Install the hex jam nut and flat washer onto the end of the throttle cable. Secure the cable to the throttle pedal. Secure with the cable clamp and two locknuts.
2. Align the throttle pedal assembly with its mount holes on the cab floor.
3. Install three capscrews securing the throttle pedal assembly to the cab floor. Torque the capscrews to 12 Nm (9 lb-ft).
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

c. Throttle Adjustment

1. From within the cab, lightly depress the accelerator pedal to the full-throttle position. As needed, adjust the limit-stop screw until it touches the pedal. Tighten the locknut.



Cab and Covers



IMPORTANT: During the full throttle check:

- **DO NOT** operate any hydraulic function.
- **DO NOT** steer or apply any pressure to the steering wheel.
- Keep the transmission in (N) NEUTRAL.

2. Check the engine rpm at full throttle. If the rpm is not 2340 ± 50 rpm, readjust the throttle limit-stop screw at the throttle pedal within the cab.

4.3.4 Joystick Assembly Replacement

a. Joystick Assembly Removal

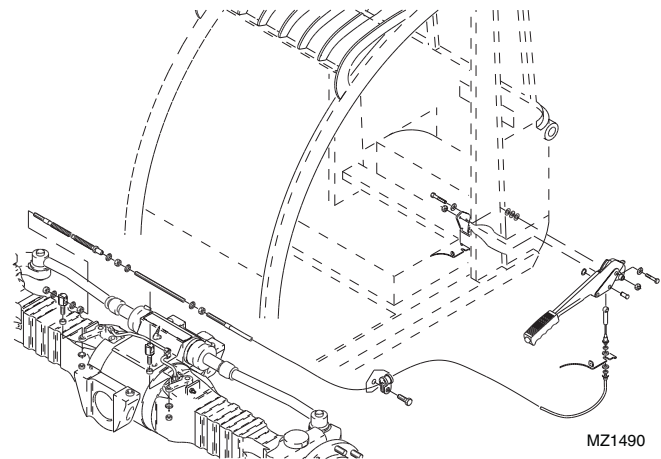
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the two capscrews. Remove the bottom cover. Disconnect the electrical connections and remove the four self-tapping screws from the bottom of the joystick assembly.
6. Remove the joystick assembly.

b. Joystick Assembly Installation

1. Set the joystick assembly into the armrest support.
2. Install the four self-tapping screws. Connect the electrical connections.

3. Connect the battery negative (-) cable to the battery negative (-) terminal.
4. Test the boom joystick functions:
 - a. Move the joystick handle rearward, activating the boom lift function. The boom should RISE.
 - b. Move the joystick handle forward, activating the boom lower function. The boom should LOWER.
 - c. Move the joystick handle to the right, activating the boom extend function. The boom should EXTEND.
 - d. Move the joystick handle to the left, activating the boom retract function. The boom should RETRACT.
 - e. Move the joystick rocker switch forward activating the boom extend function. The boom should EXTEND.
5. Install the bottom cover and secure using two lens-head capscrews.
6. Close and secure the engine cover.

4.3.5 Parking Brake



a. Park Brake Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Block the wheels.
4. Remove the cover from around the park brake lever.
5. Disconnect the park brake electrical connector switch.



6. Remove the pin attached to the park brake cable from the park brake lever.
7. Remove the bolts holding the park brake lever to the mounting plate.
8. Loosen the nuts securing the park brake cable to the mounting plate.
9. Feed the cable end through the bottom of the cab.
10. If necessary, remove the cable clamp from under the cab.

Note: Record the routing of the park brake cable for later installation.

11. Remove the cable mounting hardware on the front axle to free the park brake cable.

b. Park Brake Installation

1. Install the park brake cable on the front axle.
2. Route the park brake cable using the previous routing path.
3. Feed the cable end through the bottom of the cab.
4. Secure the park brake lever to the mounting plate using the pre-existing mounting hardware.
5. Secure the park brake cable to the park brake lever with the pre-existing pin.
6. Connect the park brake electrical connector switch.
7. Test the park brake for proper functionality.
8. With the park brake applied, check the display panel for the proper indicator light.
9. Reinstall the cover around the park brake lever.
10. Unblock the wheels.

4.3.6 Windshield Wiper Assembly

Refer to Section 9.10.1, "Windshield Wiper Motor," for removal and installation information.

4.3.7 Windshield Washer Assembly

Refer to Section 9.10.3, "Windshield Washer Reservoir and Pump," for removal and installation information.

4.3.8 Heater/Defroster System

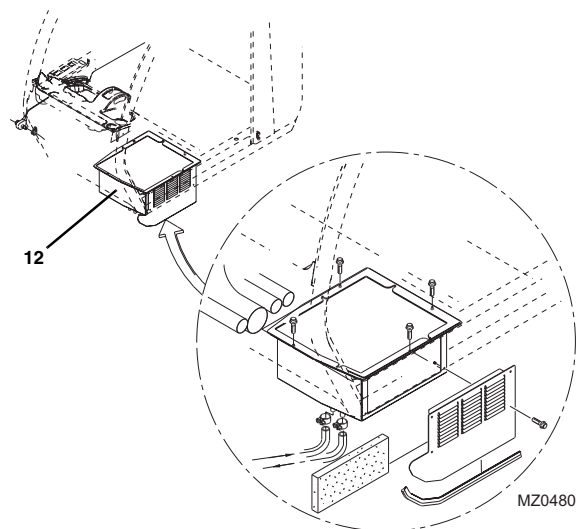
a. Heater Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.

2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the belly pan.
6. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
7. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug and slowly remove to allow the coolant to drain. Transfer the coolant into a suitable, covered container and label as "Used Coolant". Dispose of the used coolant at an approved recycling facility. Clean and reinstall the drain plug.
8. Remove the cab bottom shield.
9. Remove the cab floor mat to gain access to the heater assembly mounting bolts.

Note: Label all hoses to ensure correct installation.

10. Loosen the hose clamps and disconnect the two heater hoses.
11. Remove the heat duct hoses from the back side of the heating unit assembly.
12. Carefully lower the heater assembly (12) by hand. Label and disconnect the wiring harness connections at the blower.
13. Remove the heater assembly.





Cab and Covers

b. Heater Assembly Installation

1. Connect the wiring harness connections to the blower.
2. Lift the heater assembly to the bottom of the cab floor, and secure with bolts, lockwashers and nuts.
3. Connect the previously labeled hoses to the heater. Secure with hose clamps.
4. Fill the cooling system completely with a 50/50 mixture of ethylene glycol and water, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.4, "Fluids, Lubricants and Capacities."
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Start the engine and run at low idle. Check for any visual signs of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.
7. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.
8. Replace the cab bottom shield.
9. Replace the belly pan.
10. Close and secure the engine cover.

4.4 CAB REMOVAL

IMPORTANT: To help ensure safety and optimum performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.

Before performing any inspection, maintenance or service operation, thoroughly clean the machine. **DO NOT** spray water or cleaning solution in, on, near or around the operator's dash panels and electrical components.

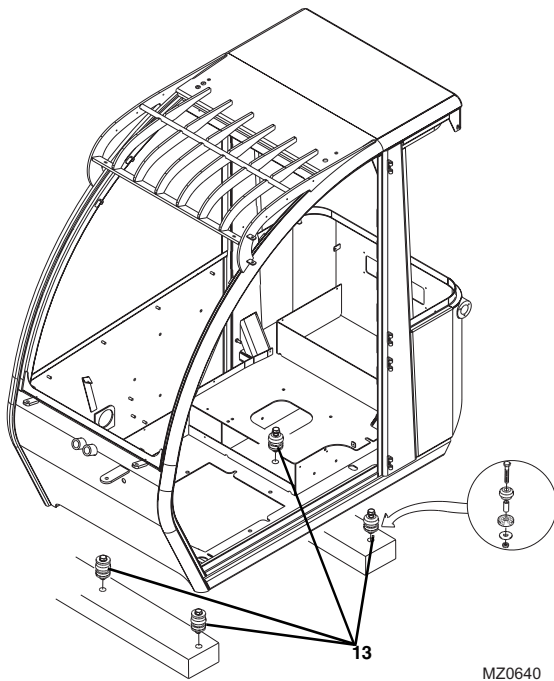
Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact your local **JLG** distributor with any questions about the suitability or condition of a cab.

IMPORTANT: Remove and label cab components as needed before removing the cab from the machine. Label, disconnect and cap hydraulic hoses. Transfer cab parts to the replacement cab after the replacement cab is securely mounted on the machine.

1. Park the machine on a firm, level surface, level the machine. Allow sufficient overhead and side clearance for cab removal. Fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Block the wheels.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the belly pan.
6. Drain the engine radiator. Refer to Section 7.4.3, "Radiator/Oil Cooler and Coolant Heater Replacement."
7. Working under the cab, remove the cab bottom shield.
8. Label, disconnect and cap the heater hoses.
9. Remove the lens-head screws in the cab and remove the console panel below the right side window to access the wire harness connections, the right rear side panel and the left rear cup holder panel to access the two rear cab mount bolts. Also remove the rubber floor mat to access the front two cab mount bolts.
10. Disconnect the cab-to-wiring harness connectors at the circuit board. Push the harness connectors through the opening at the right front corner of the cab.
11. Remove the park brake cover. Disconnect the park brake switch connector and park brake cable.
12. Working under the cab, label, disconnect and cap the hydraulic hoses at the cab fittings. Plug the hoses and cap the fittings.
13. Disconnect the throttle cable from under the cab.
14. Install two lifting eye bolts with a suitable lifting capacity in the existing threaded holes at the top corners of the windshield.
15. Secure the cab with a hoist or overhead crane and sling. Do not lift the cab at this time.
16. Remove the four cab-to-frame bolts (13), flat washers and nuts.
17. Remove the mirrors and all other cab components as needed, if not previously removed.
18. Use a hoist or overhead crane and sling attached to the cab, carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed.



19. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift the cab and remove it from the frame.
20. When the cab is completely clear of the machine, carefully lower it to the ground. Block up or support the cab so that it does not move or fall over. Assure that no personnel enter the cab while it is being removed from the machine.
21. Inspect the condition of the fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
22. Inspect and replace other machine parts that are exposed with the cab removed. Repair or replace as required.

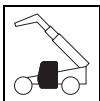


4.5 CAB INSTALLATION

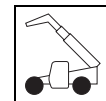
1. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab installation.
2. Attach a sling with suitable lifting capacity through the previously installed eye bolts on top of the cab.
3. Using a hoist or overhead crane and sling attached to the two lifting eyes, carefully begin to align the cab with the mounting holes in the frame. Stop and check that wiring, hydraulic hoses, cables, etc., will not be pinched or damaged as the cab is positioned. Readjust the position of the sling as needed to help balance the cab during installation.
4. Install the four bolts through the cab/frame mounts and install the four washers and nuts. Remove the sling and both lifting eye bolts. Tighten and torque the four mounting bolts to 150 Nm (110 lb-ft).
5. Secure the throttle cable to the hydraulic hoses using wire ties.
6. Install the throttle cable on the throttle cable bracket, attach the clip/pin through the fork link.
7. Working under the cab, uncap and connect the hydraulic hoses at the cab fittings.
8. Route any hoses through the opening at the right front corner of the cab.
9. Route the wiring harness connectors through the opening at the right front corner of the cab and up into the side console.
10. Connect the cab-to-wiring harness connectors.
11. Connect the park brake cable and switch connector to the park brake lever. Reinstall the park brake cover.
12. Install the right side console panel, the right rear side panel, the left rear cup holder panel and the rubber floor mat.
13. Working under the cab, connect the coolant hoses to the heater hoses. Secure with two hose clamps.
14. Fill the cooling system completely with a 50/50 mixture of ethylene glycol and water, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.4, "Fluids, Lubricants and Capacities."
15. Connect the battery negative (-) cable to the battery negative (-) terminal.
16. Start the engine and check the operation of all controls. Check for hydraulic leaks. Check the hydraulic fluid level in the tank and add fluid as required.

IMPORTANT: When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.

17. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.
18. Reinstall engine belly pan.
19. Reinstall the cab bottom shield.
20. Close and secure the engine cover.
21. Unblock the wheels.



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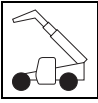


Section 5

Axles, Drive Shafts, Wheels and Tires

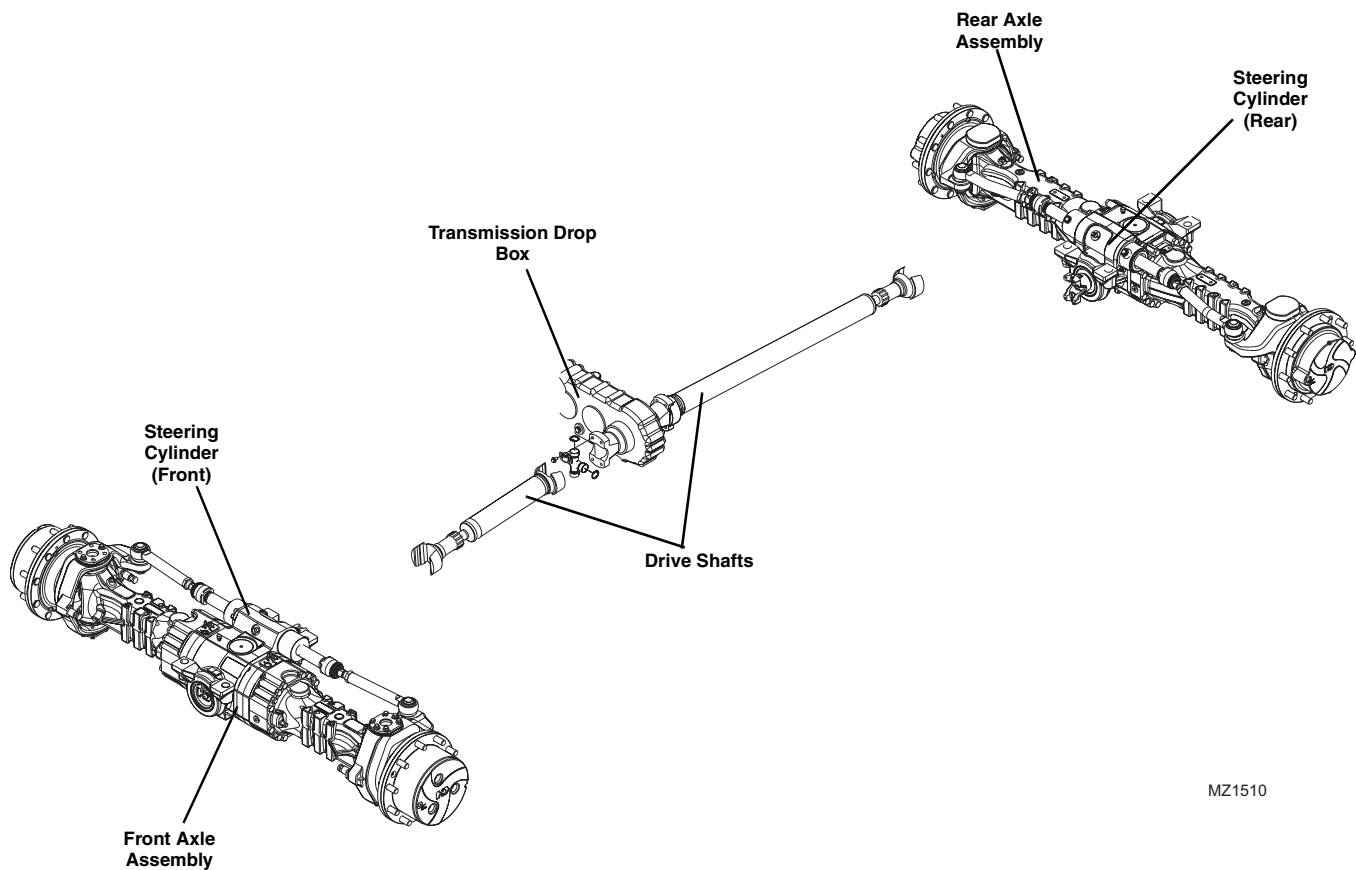
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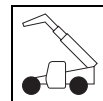


5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section.



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5.2 GENERAL INFORMATION

IMPORTANT: To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.

Before performing any inspection, maintenance or service operation, thoroughly clean the unit. The axles and drive shafts should be checked and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Use suitable products to thoroughly clean all disassembled mechanical parts to help prevent personal injury to the worker and prevent damage to the parts. Carefully inspect the integrity of all moving parts (bearings, yokes, tubes, gears, shafts, etc.) and fasteners (nuts, bolts, washers, etc.) as they are subject to major stress and wear. Always replace elastic locknuts and any damaged, worn, cracked, seized or otherwise improper parts that could affect the safe and proper functioning of the machine, axles and drive shafts.

5.3 AXLE ASSEMBLIES

5.3.1 Axle Serial Number Plate

The front and rear axle serial number plate is located on a mounting pad on the front side of the center section of each axle. Information on the serial number plate is required in correspondence regarding the axle.

Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

5.3.2 Axle Specifications

General axle specifications are found in Section 2.4, "Fluids, Lubricants and Capacities."

5.3.3 Axle Internal Service

Detailed axle service instructions (covering the axle, differential, brakes and wheel-end safety, repair, disassembly, reassembly, adjustment and troubleshooting information) are provided in the Dana Spicer Maintenance and Repair Manual (P/N 31200162).



WARNING: DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices," of this manual. Failure to follow the safety practices may result in death or serious injury.

5.3.4 Axle Maintenance

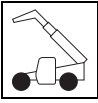
CLEANING: Clean parts with machined or ground surfaces (such as gears, bearings and shafts) with emulsion cleaners or petroleum-based cleaners. **DO NOT** steam clean internal components and the interior of the planetary hub and axle housing. Water can cause corrosion of critical parts. Rust contamination in the lubricant can cause gear and bearing failure. Remove old gasket material from all surfaces.

DRYING: Use clean, lintless towels to dry components after cleaning. **DO NOT** dry bearings by spinning them with compressed air; this can damage mating surfaces due to lack of lubrication. After drying, lightly coat components with oil or a rust-preventive chemical to help protect them from corrosion. If storing components for a prolonged period, wrap them in wax paper.

PERIODIC OPERATION REQUIREMENT: Every two weeks, drive the machine far enough to cause the drive-train components to make several complete revolutions. This will help ensure that internal components receive lubrication to minimize deterioration caused by environmental factors such as high humidity.

SUBMERSION: If the machine has been exposed to water deep enough to cover the hubs, disassemble the wheel ends and inspect for water damage and contamination. If the carrier housing was submerged in water, especially if the water level was above the vent tube (breather), drain the axle and inspect internal parts for water damage and contamination. Before assembling and refilling the unit with the specified lubricant(s), clean, examine and replace damaged parts as necessary.

Note: Use a suitable puller for bearing removal. Clean, inspect and lubricate all bearings just prior to reassembly. If replacement of a damaged bearing cup or cone is necessary, replace the cup and cone as a set.



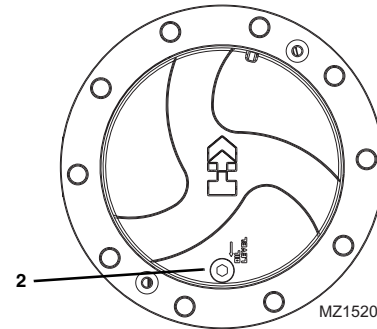
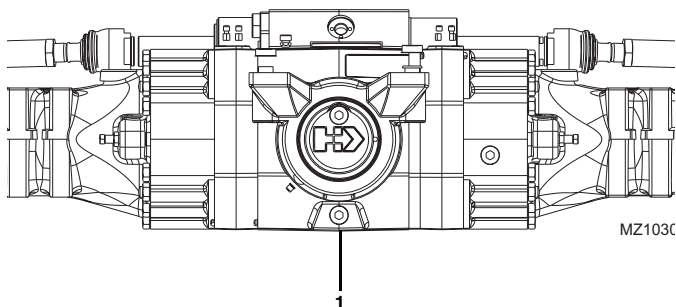
5.3.5 Axle Removal

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; the rear axle has neither. The following steps outline a typical axle removal procedure, suitable for either the front or the rear axle assembly.

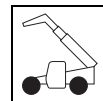
Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on the outrigger solenoids and other electrical components. If using a steam cleaner, seal all openings before steam cleaning.

IMPORTANT: Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. If the axle will be disassembled after removal, place a suitable receptacle under the axle (1) and wheel hubs drain plugs (2). Remove the drain plugs and allow the axle oil to drain into the receptacle. Transfer the used axle oil into a suitable covered container, and label the container as "Used Oil". Dispose of used oil at an approved recycling facility.



6. Label, disconnect and cap the steering and brake lines at the axle. Wipe up any spilled oil.
7. Block the front and rear of both tires on the axle that is not being removed. Ensure that the machine will remain in place during axle removal before proceeding.
8. Raise the machine using a suitable jack or hoist. Place suitable supports under both sides of the frame and lower the machine onto the supports. Ensure that the machine will remain in place during axle removal.
9. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
10. Mark and remove both wheel and tire assemblies from the axle that is being removed. (Refer to Section 5.5.1, "Removing Wheel and Tire Assembly from Machine.")
11. Remove the drive shaft assembly. Refer to Section 5.4.3, "Drive Shaft Removal."
12. On the front axle, remove the hardware securing the sway cylinder or bar (not necessary on machines with fixed axles before S/N 1160000798). Tap the mount pin out, and move the cylinder or bar to prevent it from interfering with axle removal.
13. Remove the park brake cable from the front axle.
14. Remove the bolts and locknuts securing the axle to the frame.
15. Remove the axles from the machine using the jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb the machine while removing the axle. Balance the axle and prevent it from tipping, turning or falling while removing it from beneath the machine. Place the axle on a suitable support or holding stand.



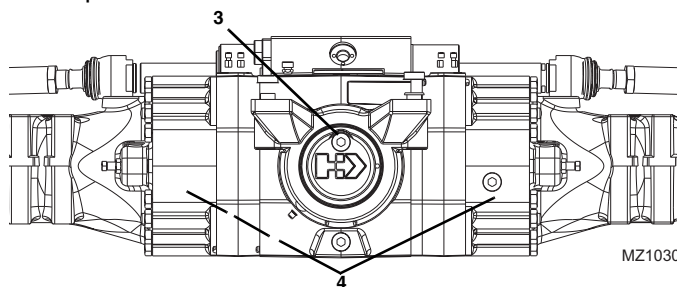
c. Axle Installation

The front and rear axle assemblies differ in that the front axle assembly is equipped with a parking brake mechanism and limited-slip feature; the rear axle has neither. The steps below outline a typical axle installation procedure, suitable for either the front or the rear axle assembly.

1. Before proceeding, ensure that the machine will remain in place during axle installation. Block the front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise the machine using a suitable jack or hoist. Place suitable supports beneath the frame and lower the machine onto the supports, allowing enough room for axle installation. Ensure that the machine will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove the axle from its support or holding stand. Balance the axle and prevent it from tipping, turning or falling while positioning it beneath the machine. **DO NOT** raise or otherwise disturb the machine while installing the axle. Keep the axle supported and balanced on the jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position the axle under the frame, and align the axle housing with the holes in the frame.
5. Install the axle bolts and nuts. Tighten and torque the axle nuts near the pivoting bearings to 650 Nm (479 lb-ft) and the bolts in the front axle cylinder anchor plate to 550 Nm (405 lb-ft). On fixed axle machines before S/N 1160000798, tighten and torque the axle front axle nuts to 650 Nm (479 lb-ft) and the rear nuts to 550 Nm (405 lb-ft).
6. Move the cylinder into position on the axle cylinder anchor. Insert a cylinder-mount pin through the cylinder and cylinder anchor (not necessary on fixed axle machines before S/N 1160000798). Secure the cylinder-mount pin.
7. Apply a multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
8. Install the drive shaft assemblies. (Refer to Section 5.4.5, "Drive Shaft Installation.")
9. If reinstalling an axle previously removed from the machine, position the driveshaft yoke on the axle according to the alignment marks made earlier. If installing a new axle, note the position of the driveshaft yoke at the transmission. Align the

driveshaft yoke on the axle in the same plane as the yoke on the transmission.

10. Tighten the axle oil drain plug, loosen and remove the axle oil fill plug (3). Fill the axle through the axle fill plug until the oil level is even with the oil check level plugs (4). Refer to Section 2.4, "Fluids, Lubricants and Capacities," for proper oil and capacities.



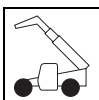
11. Rotate wheel hubs 90 degrees so the drain plug becomes the fill plug. Refer to Section 2.4, "Fluids, Lubricants and Capacities," for proper oil and capacities.
12. Install the wheel and tire assemblies. Refer to Section 5.5.2, "Installing Wheel and Tire Assembly onto Machine."

Note: Be sure the directional tread pattern "arrows" of the tires are facing in the direction of forward travel.

13. Carefully remove the jack, hoist or overhead crane and sling supporting the axle.
14. Carefully raise the machine using a suitable jack or hoist. Remove the supports from beneath the frame and lower the machine to the ground.

Note: ALWAYS use new o-rings when servicing the machine.

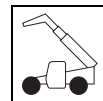
15. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
16. Uncap and connect the steering and brake lines at their axle fittings.
17. Install the park brake on the front axle.
18. Bleed brakes as necessary. Refer to Section 8.8.3, "Brake Test."
19. Check the hydraulic reservoir oil level.
20. Unblock the wheels.
21. Start the engine. Turn the steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.
22. Close and secure the engine cover.



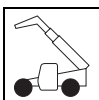
Axles, Drive Shafts, Wheels and Tires

5.3.6 Axle Assembly and Drive Shaft Troubleshooting

Problem	Cause	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level with Mobilfluid 424® ISO 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level with Mobilfluid 424® ISO 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint assembly(ies) incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft(s) damaged/unbalanced.	3. Replace drive shaft(s) as needed.

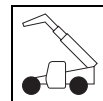


Problem	Cause	Remedy
4. Oil leaking from axle (differential housing and/or axle housings).	1. Drain and/or inspection plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 130 Nm (96 lb-ft).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Dana Repair Manuals.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 390 Nm (288 lb-ft).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
5. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 130 Nm (96 lb-ft).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 55 Nm (41 lb-ft).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).
6. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.



Axles, Drive Shafts, Wheels and Tires

Problem	Cause	Remedy
7. Axle overheating.	<ol style="list-style-type: none"> 1. Oil level too high. 2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low. 3. Dragging park brake. 	<ol style="list-style-type: none"> 1. Fill oil to correct level with Mobilfluid 424® ISO 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities." 2. Drain axle and fill to correct level with Mobilfluid 424® ISO 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities." 3. Adjust park brake cable as needed.
8. High steering effort required.	<ol style="list-style-type: none"> 1. Steering (hydraulic) system not operating properly. 2. Excessive joint housing swivel bearing preload. 3. Worn or damaged swivel bearings. 	<ol style="list-style-type: none"> 1. Refer to Section 8.9.8, "Steering Cylinders." 2. Correct bearing preload by adding or removing shims as needed. 3. Replace swivel bearings as needed.
9. Slow steering response.	<ol style="list-style-type: none"> 1. Steering (hydraulic) system not operating properly. 2. Steering cylinder leaking internally. 	<ol style="list-style-type: none"> 1. Refer to Section 8.9.8, "Steering Cylinders." 2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	<ol style="list-style-type: none"> 1. Brake discs worn. 2. Brake discs damaged. 	<ol style="list-style-type: none"> 1. Check brake discs for wear. Refer to Section 5.6, "Brakes." 2. Replace brake discs.
11. Brakes will not engage.	<ol style="list-style-type: none"> 1. Brake (hydraulic) system not operating properly. 2. Brake piston o-rings and seals damaged (leaking). 	<ol style="list-style-type: none"> 1. Refer to Section 8.8.3, "Brake Test." 2. Replace o-rings and seals.
12. Brakes will not hold the machine or braking power reduced.	<ol style="list-style-type: none"> 1. Brake discs worn. 2. Brake (hydraulic) system not operating properly. 3. Brake piston o-rings and seals damaged (leaking). 	<ol style="list-style-type: none"> 1. Check brake discs for wear. Refer to Section 5.6, "Brakes." 2. Refer to Section 8.8.3, "Brake Test." 3. Replace o-rings and seals.



5.4 DRIVE SHAFTS

5.4.1 Drive Shaft Inspection and Service

Whenever servicing the machine, conduct a visual inspection of the drive shaft and cross and bearing assembly (universal joints, or U-joints). A few moments spent doing this can help prevent further problems and down time later.

Inspect area where the drive shaft flange yoke and slip yoke mount to the drive shaft. Attempt to turn drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shaft and cross and bearing assembly may cause an excessive amount of vibration or noise.

5.4.2 Drive Shaft Maintenance

Refer to Section 2.6, "Lubrication Schedules," for information regarding the lubrication of the grease fittings on the drive shafts.

5.4.3 Drive Shaft Removal

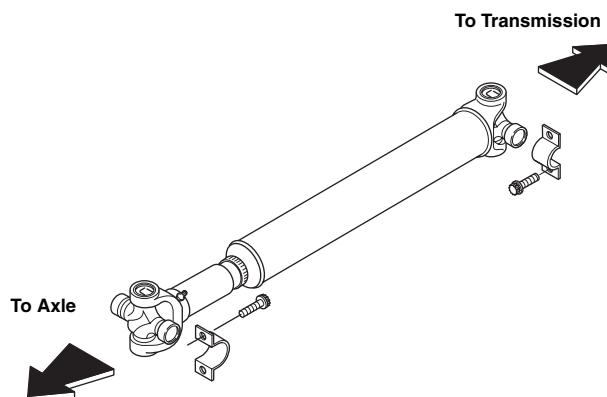
IMPORTANT: To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.

Note: The drive shaft assemblies are balanced assemblies. Mark the yoke and axle, transmission, transfer case, and the shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Block the wheels.
6. The drive shaft assembly is a balanced assembly. Mark the yoke and axle, transmission and the shaft and slip yoke so that these components can be

returned to their original positions when reinstalled. Yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.

7. Remove the four capscrews and two straps securing the bearing cross to the transmission output shaft flange.
8. Remove the four capscrews and two straps securing the bearing crosses to the axle.
9. Remove the front drive shaft assembly.
10. Repeat the above procedure for the rear drive shaft.



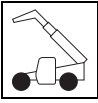
5.4.4 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts using an approved cleaning fluid. Allow to dry.
2. Remove any burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.4.5 Drive Shaft Installation

IMPORTANT: To help ensure optimum performance, the drive shaft assemblies are specially balanced as a unit at the factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.

1. Raise the drive shaft assembly into position. The slip-yoke end of the drive shaft mounts toward the axle. If reinstalling a drive shaft previously removed, align the flange yokes according to the alignment marks made during removal.
2. Install the four capscrews and two straps securing the bearing crosses to the transmission. Torque the capscrews to 38 Nm (28 lb-ft).
3. Install the four capscrews and two straps securing the bearing crosses to the axle. Torque the capscrews to 38 Nm (28 lb-ft).
4. Repeat the above procedure on the rear drive shaft.



Axles, Drive Shafts, Wheels and Tires

5. Connect the battery negative (-) cable at the battery negative (-) terminal.
6. Unblock the wheels.
7. Close and secure the engine cover.

5.5 WHEELS AND TIRES



WARNING: Risk of death or serious personal injury. Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise machine stability and may cause machine to tip over.

JLG recommends a replacement tire to be the same size, ply and brand as originally installed. Refer to the appropriate parts manual for ordering information. If not using a JLG approved replacement tire, JLG recommends that replacement tires have the following characteristics:

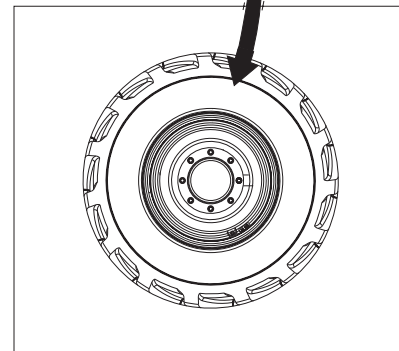
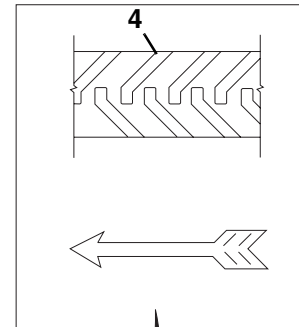
- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

The tires are filled with air only when the machine leaves the factory. JLG does not recommend the use of hydrofill as a tire-fill substance because of possible environmental impact.

Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.

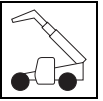
The wheel and tire assemblies must be installed with the directional tread pattern “arrows” (4) facing in the direction of forward travel.



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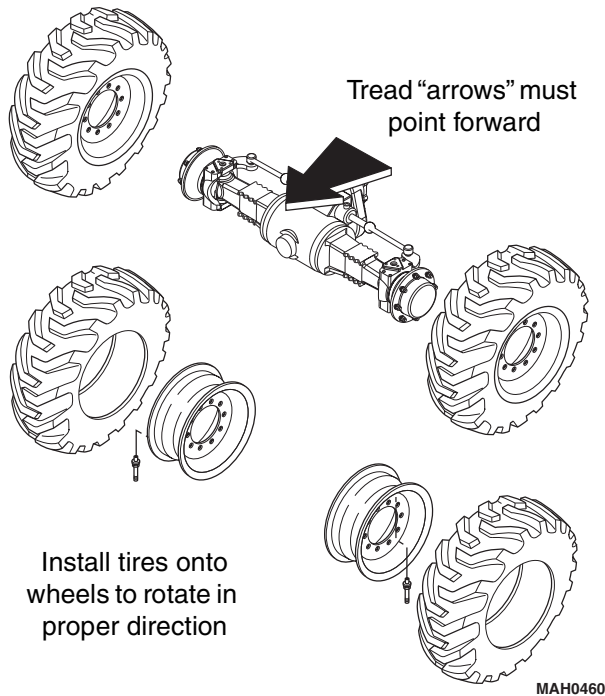
5.5.1 Removing Wheel and Tire Assembly from Machine

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Loosen, but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.
4. Place a suitable jack under the axle pad closest to the wheel being removed. Raise the machine and position a suitable support beneath the axle. Allow sufficient room to lower the machine onto the support and to remove the wheel and tire assembly.
5. Lower the machine onto the support.
6. Remove lug nuts and lug washers in an alternating pattern.
7. Remove the wheel and tire assembly from the machine.

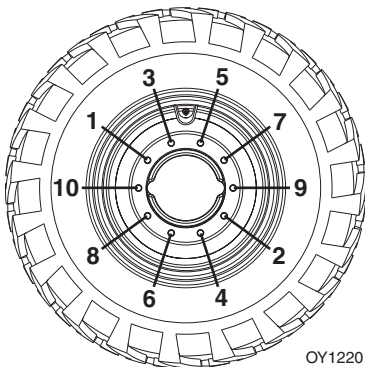


5.5.2 Installing Wheel and Tire Assembly onto Machine

IMPORTANT: The wheel and tire assemblies must be installed with the directional tread pattern “arrows” facing in the direction of forward travel.



1. Position wheel onto studs on wheel end of axle.
2. Install wheel lug washers.
3. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.
4. Tighten lug nuts in an alternating pattern as indicated in figure. Torque to 500 Nm (367 lb-ft).



5. Remove machine from supports.

5.6 BRAKES

5.6.1 Brake Disk Inspection.

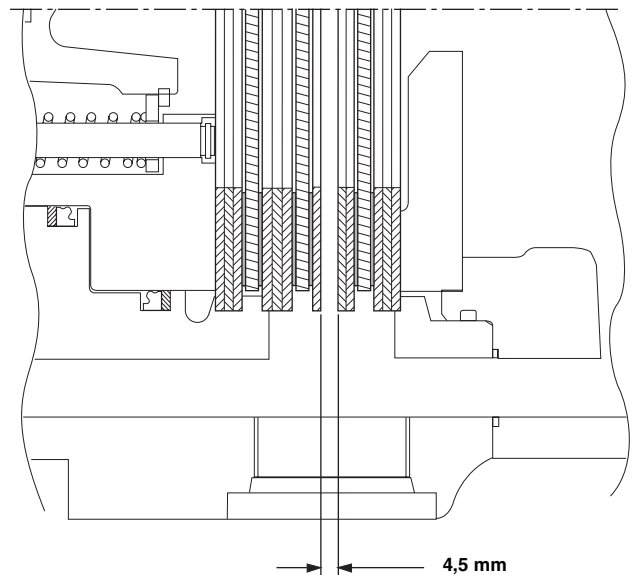
a. Front and Rear Axles

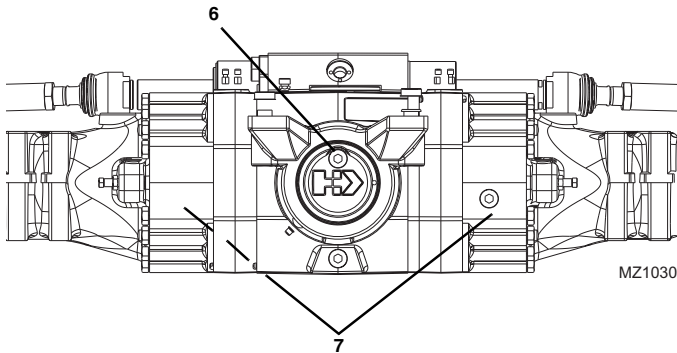
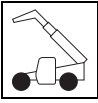


WARNING: BLOCK ALL FOUR WHEELS. Failure to do so could result in death or serious injury from machine roll-away.

1. Block all four wheels to help prevent the machine from moving after the parking brake is disabled.
2. Remove the oil-level plug (7) on each side of the axle.
3. Have an assistant sit in the cab and apply the brakes, keeping pressure applied.
4. Using a feeler gauge, check the gap between the brake discs. If the gap is less than 4,5 mm (0.18"), replace the brake discs.

Note: If the brake discs are worn beyond their tolerance, the brake disc must be replaced on both sides of the axle at the same time.



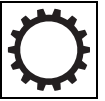


5. Repeat steps 3 and 4 for the other side of the axle.
6. Fill the axle through the axle fill plug (6) until the oil level is even with the oil check level plugs (7). Refer to Section 2.4, "Fluids, Lubricants and Capacities," for proper oil and capacities.

5.7 TOWING A DISABLED MACHINE

Towing a disabled machine should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the machine, and move it under its own power, before using the emergency towing procedures outlined below.

1. Secure the machine to a suitable towing vehicle.
2. Release the park brake and set the transmission control lever in (N) NEUTRAL.
3. Tow the machine to a suitable repair facility.
4. After towing is complete, engage the park brake.



Section 6

Transmission:

Contents

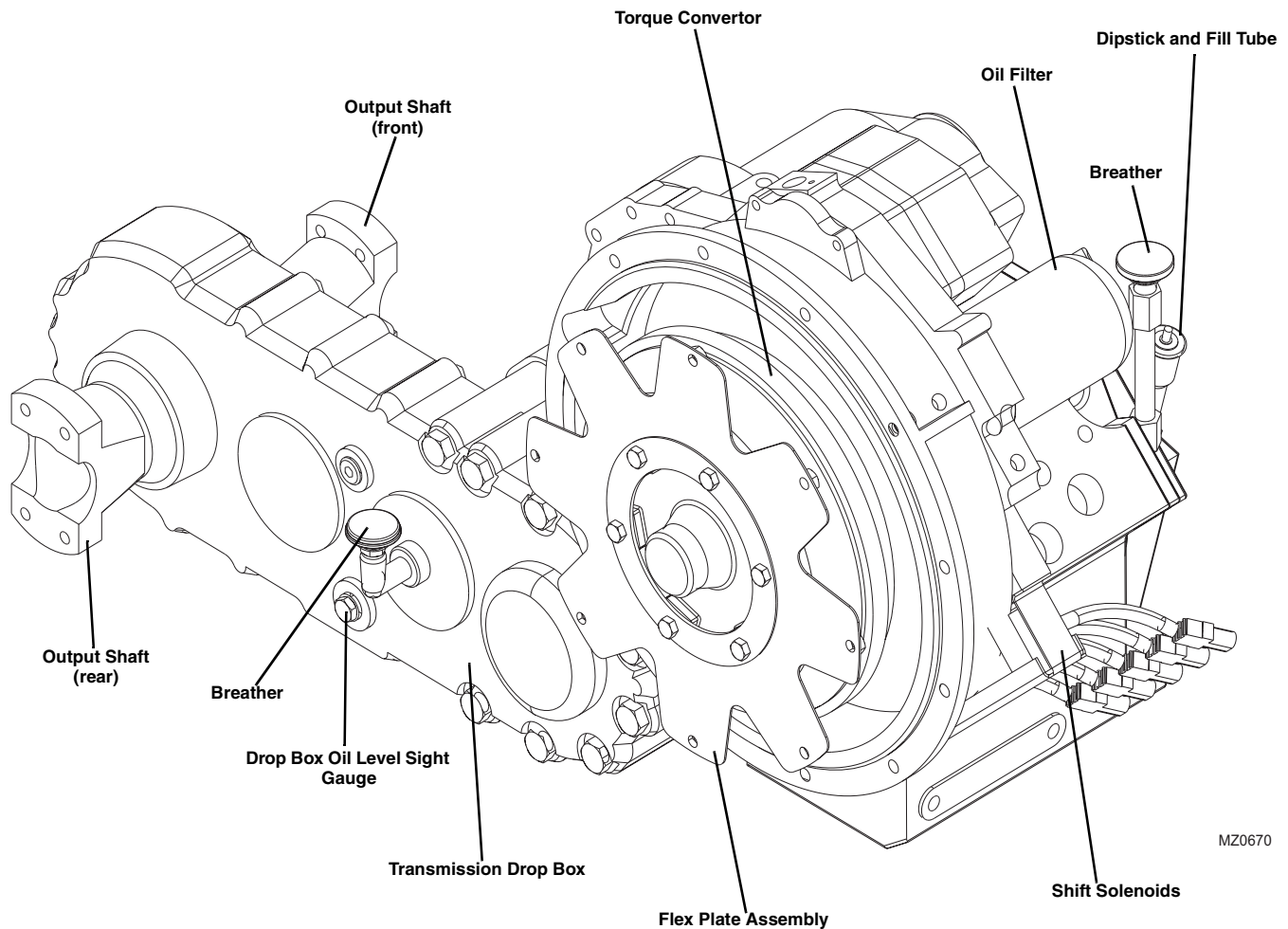
PARAGRAPH	TITLE	PAGE
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6.3	Transmission Serial Number	6.3
6.4	Transmission Specifications	6.3
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Transmission:

6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.



6.2

3507, 3508, 3509, 3512, 3513, 4007, 4008, 4009, 4012, 4013



WARNING: DO NOT service the machine without following all safety precautions as outlined in Section 1, "Safety Practices," of this manual. Failure to follow the safety practices may result in death or serious injury.

6.2 TRANSMISSION DESCRIPTION

Instructions in this section pertain mainly to general specifications, towing, maintenance information, and transmission removal and installation procedures. For internal transmission service instructions and detailed specifications contact your local JLG distributor for a copy of the Dana Spicer Repair Manual (P/N 31200163).

6.3 TRANSMISSION SERIAL NUMBER

The transmission serial number plate is located on the front of the transmission case below the convertor housing. Information specified on the serial number plate includes the transmission model number, the transmission serial number and other data. Information on the serial number plate is required in correspondence regarding the transmission.

6.4 TRANSMISSION SPECIFICATIONS

6.4.1 Transmission Maintenance

Cleanliness is of extreme importance. Before attempting any repairs, thoroughly clean the exterior of the transmission to help prevent dirt from entering while performing maintenance checks and procedures.

Section 2.5, "Maintenance Schedules," provides a suggested maintenance schedule with references to pertinent procedures and instructions in this manual. To help prevent transmission problems before they occur, follow the maintenance schedule.

Note: Lubrication and Maintenance chart decals are located inside the rear door of the machine or in the cab. These decals contain a general maintenance schedule that should be followed to maintain the machine in good operating condition. Refer to Section 2.6, "Lubrication Schedules." The same schedule information is presented in the appropriate Operation & Safety Manual, with a detailed account of how to perform the procedures.

6.4.2 Transmission Maintenance Schedule

Complete transmission maintenance information is located in the appropriate Operation & Safety Manual.

- At ten hour intervals, check the transmission oil level. Refer to the appropriate Operation & Safety Manual.
- When the machine completes it's first 50 hours of use, change the transmission filter and oil. Refer to the appropriate Operation & Safety Manual.
- At 1,000 hour intervals, change the transmission oil and filter. Refer to the appropriate Operation & Safety Manual.

Periodically, depending on operating conditions and other factors, back flush the transmission oil cooler, which is located in or behind the radiator. ALWAYS back flush the transmission oil cooler after removing the transmission for repair or replacement.

The transmission oil cooler outlet hose, routed to the lower oil cooler fitting, is located on the top of the transmission. The transmission oil cooler inlet hose, routed to the upper oil cooler fitting, is located on the top of the transmission (Refer to Section 7.4, "Engine Cooling System.")

Disconnect and back flush the oil cooler portion of the radiator or the oil cooler with oil and compressed air until all foreign material is removed. If necessary, remove the radiator or oil cooler from the machine, and clean the oil cooler circuit using oil, compressed air and steam.

IMPORTANT: DO NOT use flushing compounds for cleaning purposes.

6.5 TRANSMISSION REPLACEMENT

Note: Contact the JLG Service Department if internal transmission repair is required during the warranty period.

IMPORTANT: To help ensure safety and optimum performance, replace the transmission if it is damaged. Refer to the appropriate Parts Manual for ordering information.

Cleanliness is of extreme importance. Before attempting to remove the transmission, thoroughly clean the exterior of the transmission to help prevent dirt from entering during the replacement process. Avoid spraying water or cleaning solution onto or near the transmission shift solenoids and other electrical components.



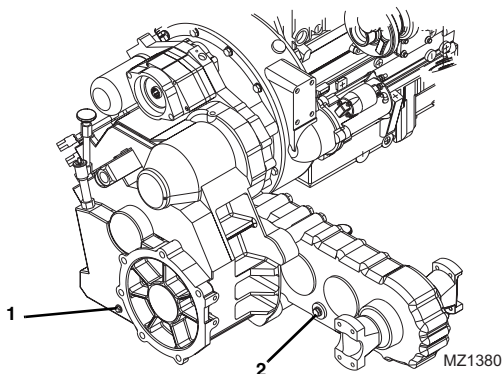
Transmission:

6.5.1 Transmission Removal



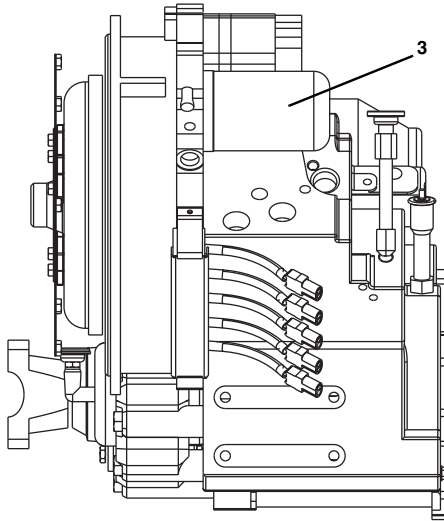
WARNING: Risk of severe personal injury. **NEVER** lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Remove the engine cover to allow easier access to the transmission.
5. Remove the belly pan from under engine.
6. Disconnect the (+) positive and (-) negative battery cables and remove the battery.
7. Thoroughly clean the transmission and surrounding area, including all hoses and fittings, before proceeding.
8. Place a suitable receptacle under the transmission drain plug (1). Remove the transmission drain plug and allow the transmission oil to drain into the receptacle. Repeat drain procedure with the drop box (2).
9. Transfer the used transmission oil into a suitable, covered container, and label the container "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.
10. Remove the drive shafts. Refer to Section 5.4.3, "Drive Shaft Removal."
11. Remove the air cleaner unit and intake tubes.
12. Remove the hydraulic pump. Refer to Section 8.7.3, "Pump Replacement."
13. Label and disconnect the transmission temperature switch connector and shift solenoid wiring harness connectors.
14. Label, disconnect and cap the transmission oil cooler inlet and outlet hoses at the transmission. The transmission oil cooler outlet hose, routed to the lower radiator fitting, is located on the top of the transmission. the transmission oil cooler inlet hose, routed to the upper radiator fitting, is located on top of the transmission.
15. Remove the access plug from the side of the engine bell housing. This will allow access to remove the eight bolts holding the flex plate to the engine flywheel.
16. Turn the engine over slowly by hand and align each of the eight flex plate bolts to be accessed. Remove them one at a time.
17. Wipe up any spilled hydraulic and transmission oil.
18. Connect a lifting strap or chain to the lifting eye at the top of the transmission, and to a suitable hoist or overhead crane. Operate the hoist or crane to remove slack from the chain, but **DO NOT** raise the transmission at this time.
19. Place blocks under the rear of engine for support BEFORE transmission mounts are removed.
20. Place blocks under the transmission to help support it during removal.
21. Remove both rear transmission mount bolts and lockwashers securing the transmission mount to the frame.
22. Remove the ten bolts and washers holding the transmission to the engine.
23. Remove the four capscrews and four lockwashers securing each rear transmission mount to the transmission.
24. Remove the two transmission mount from the machine.
25. Inspect the rubber mounts. Replace the mounts if damaged.
26. Carefully remove the transmission from the machine. Avoid causing damage to the transmission or surrounding parts.
27. Lift the transmission clear of the machine, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.





28. Remove any external transmission components as required, including the transmission temperature switch, and inlet and outlet cooler hose fittings. Cover all transmission openings.
29. Remove the transmission oil filter (3) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.



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30. If transmission oil is suspected of contamination or torque converter is damaged, remove the converter and flex plate from the transmission.
31. Remove the six bolts and washers holding the converter to the flex plate.

6.5.2 Transmission Inspection and Internal Repair

If replacing the entire transmission, transfer the transmission temperature switch to the replacement transmission. The gear shift solenoids are included with a new transmission.

Detailed internal service instructions are provided in the Dana Spicer Repair Manual, which can be obtained by contacting your local JLG Distributor.

6.5.3 Transmission Installation

1. Install both the rear transmission mounts on the transmission. Torque capscrews to 120 Nm (88 lb-ft).
2. Install guide studs near the top of the bell housing holes and in the flex plate.
3. Use a hoist or overhead crane and sling attached to the lifting eye at the top of the transmission. Raise and position the transmission within the chassis.
4. Align the torque converter, align the transmission bolt holes with the guide studs in the bell housing and flex plate. Install the eight bolts and washers and torque to 63 Nm (46 lb-ft). Remove the alignment studs and install and torque the last two transmission mount bolts and torque to 63 Nm (46 lb-ft).
5. Install the two rear transmission mounting bolts on the frame with two capscrews and two lockwashers. Apply Loctite® 242 threadlock to the transmission mount bolts and torque to 210 Nm (155 lb-ft).
6. Turn the engine over slowly by hand and align each of the eight flex plate bolts to be accessed. Install them one at a time. Torque to 35-39 Nm (26-29 lb-ft). Replace access plug.
7. Remove the hoist or overhead crane and sling.
8. Connect the transmission temperature switch connector and shift solenoid wiring harness connectors.
9. Secure the wiring harness to the transmission housing.
10. Uncap and connect the transmission oil cooler inlet and outlet hoses at the transmission.
11. Install the hydraulic pump. Refer to Section 8.7.3, "Pump Replacement."
12. Install the transmission-to-axle drive shafts. Refer to Section 5.4.5, "Drive Shaft Installation."
13. Install air cleaner and tubing.
14. Clean the transmission oil filter mounting surface.
15. Apply a thin film of clean Mobilfluid 424® ISO Grade 46 to the new transmission filter gasket. Install the new filter and torque to 27-34 Nm (20-25 lb-ft).
16. Transmission oil may be added through the dipstick tube. Remove the dipstick and add approximately 11,4 liters (3 Gallons) of Mobilfluid 424® ISO Grade 46. Check the oil level by taking intermittent dipstick readings as outlined in the appropriate



Transmission:

Operation & Safety Manual. **DO NOT** overfill.
Reinstall the dipstick when finished.

17. Install the belly pan under the engine.
18. Install the engine cover.
19. Install the battery and reconnect the positive (+) and negative (-) cables.
20. Close and secure the engine cover.

6.5.4 After Transmission Service or Replacement

Refer to the Dana Spicer Transmission Repair Manual which can be obtained by calling your local JLG Distributor.

In General:

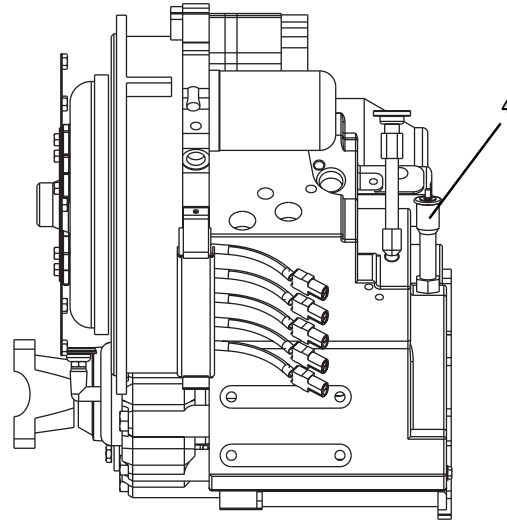
1. Check the transmission oil level and add oil as required.
2. Install a new transmission filter.
3. Check the torque on the drive shaft yoke capscrews.
4. Wear suitable eye protection. When an overhauled or repaired transmission is installed, thoroughly clean the oil cooler lines to and from the transmission.
5. Drain and flush the entire system.
6. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
7. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.

CAUTION: **DO NOT** exceed 11,4 bar (165 psi) when back flushing the oil cooler. Applying too much pressure may damage the oil cooler/radiator.

8. Back flush the transmission oil cooler portion of the radiator or the oil cooler (located behind the radiator) with oil and compressed air until all foreign material is removed. Flushing in the direction of normal oil flow does not adequately clean the cooler. If needed, remove the radiator or oil cooler from the machine.

IMPORTANT: **DO NOT** use flushing compounds for cleaning purposes.

9. Reassemble all components and fill the transmission with clean, fresh Mobilfluid 424® ISO Grade 46 through the dipstick tube opening (4). Remove the dipstick and fill with approximately 11,4 liters (3 gallons) of Mobilfluid 424® ISO Grade 46. Check the level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.



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10. Run the engine for two minutes at idle to help prime the torque converter and the transmission oil lines.
11. Recheck the level of the fluid in the transmission with the engine running at idle.
12. Add Mobilfluid 424® ISO Grade 46 as necessary to bring the fluid level up until it reaches the FULL mark on the dipstick. Recheck the oil level when it reaches operating temperature 83-94°C (180-200°F).
13. Recheck all drain plugs, lines, connections, etc. for leaks, and tighten where necessary.



6.6 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

Note: Contact the **JLG** Service Department if internal transmission repair is required during the warranty period.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

6.6.1 Transmission Troubleshooting

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level with Mobilfluid 424® ISO Grade 46. (Refer to Section 2.4, "Fluids, Lubricants and Capacities.")
	2. Transmission control lever not functioning properly and/or a fault in the wiring harness. Transmission control lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.5.1, "Cab Harness Electrical Schematic."
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.5.1, "Cab Harness Electrical Schematic."
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to Section 6.6.1, "Transmission Troubleshooting," Problem 2. "Low or no pump flow or pressure."
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.



Transmission:

Problem	Cause	Remedy
2. Low or no pump flow or pressure.	<ol style="list-style-type: none"> 1. Low oil level. 2. Transmission filled with incorrect oil, or oil contaminated. 3. Pump suction pipe screen clogged. 4. Central shaft damaged. 5. Pump worn or damaged. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level with Mobilfluid 424® ISO Grade 46. (Refer to Section 2.4, "Fluids, Lubricants and Capacities.") 2. Drain transmission and fill to correct level with Mobilfluid 424® ISO Grade 46. (Refer to Section 2.4, "Fluids, Lubricants and Capacities.") 3. Clean, repair and/or replace suction pipe. 4. Replace central shaft. 5. Repair or replace pump assembly.
3. Low clutch pressure.	<ol style="list-style-type: none"> 1. Incorrect oil level. 2. Main pressure valve stuck open. 3. Broken or worn coupling shaft or piston o-rings. 4. Pressure reducing valve stuck open. 	<ol style="list-style-type: none"> 1. Fill transmission to correct level with Mobilfluid 424® ISO Grade 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities." 2. Clean the valve spool and housing. 3. Replace coupling and/or o-rings. 4. Clean the valve spool and housing.
4. Lack of power.	<ol style="list-style-type: none"> 1. Park or service brake dragging. 2. Low engine rpm causes converter stall. 3. Pump output pressure is low. 4. Clutch discs worn or damaged. 5. Transmission overheating. 	<ol style="list-style-type: none"> 1. Refer to Section 8.5, "Hydraulic Schematics." 2. Adjust the engine rpm to specifications. Refer to Dana-Spicer Service Manual. 3. Refer to Section 6.6.1, "Transmission Troubleshooting," Problem 2. "Low or no pump flow or pressure." 4. Replace clutch discs. 5. Refer to Section 6.6.1, "Transmission Troubleshooting," Problem 5. "Transmission overheating (oil above 120° C (248° F))."



Problem	Cause	Remedy
5. Transmission overheating (oil above 120° C (248° F)).	1. Low oil level.	1. Fill transmission to correct level with Mobilfluid 424® ISO Grade 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	2. Clogged radiator.	2. Remove debris from the radiator.
	3. Transmission filled with incorrect oil, or oil contaminated.	3. Drain transmission and fill to correct level with Mobilfluid 424® ISO Grade 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	4. Excessive "roading."	4. Stop and idle the engine.
	5. Restriction in oil cooler hoses.	5. Replace cooler hoses.
	6. Pump worn or damaged.	6. Repair or replace pump assembly.
	7. Engine thermostat stuck.	7. Replace engine thermostat. Refer to Section 7.4.2, "Thermostat Replacement."
6. Grinding or "clunking" noise from transmission.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	2. Transmission filled with incorrect oil.	2. Drain transmission and fill to correct level with Mobilfluid 424® ISO Grade 46. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
	3. Incorrect clutch engagement.	3. Refer to Section 9.12.3, "Transmission Solenoid Valves."
	4. Internal damage.	4. Repair or replace parts as needed.
	5. Broken diaphragm (flex plate).	5. Replace diaphragm (flex plate). Refer to Section 6.5.1, "Transmission Removal."
	6. Loose diaphragm (flex plate) mounting capscrews.	6. Tighten capscrews.



Transmission:

Problem	Cause	Remedy
7. Oil leaking from transmission.	1. Oil leaking from vent (high oil level).	1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to Section 2.4, "Fluids, Lubricants and Capacities." Replace o-rings as needed and tighten plugs to 130 Nm (96 lb-ft).
	2. Drain plug loose and/or o-rings damaged or missing.	2. Replace o-rings as needed and tighten plug to 35 Nm (26 lb-ft).
	3. Hose fittings loose.	3. Tighten fittings.
	4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight).	4. Replace gaskets and/or tighten capscrews to 9,5 Nm (7 lb-ft).
	5. Housing capscrews loose.	5. Tighten capscrews to 46 Nm (34 lb-ft).
	6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight).	6. Replace o-rings and/or tighten capscrews to 115 Nm (85 lb-ft).
	7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage).	7. Replace converter and/or input shaft seal.
	8. Oil leaking at output shaft (output shaft seal damaged).	8. Replace output shaft seal.
	9. Housing damaged.	9. Replace housing as needed.



Section 7

Engine: Perkins 1104-42 & 1104-42T

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7.1 INTRODUCTION

7.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

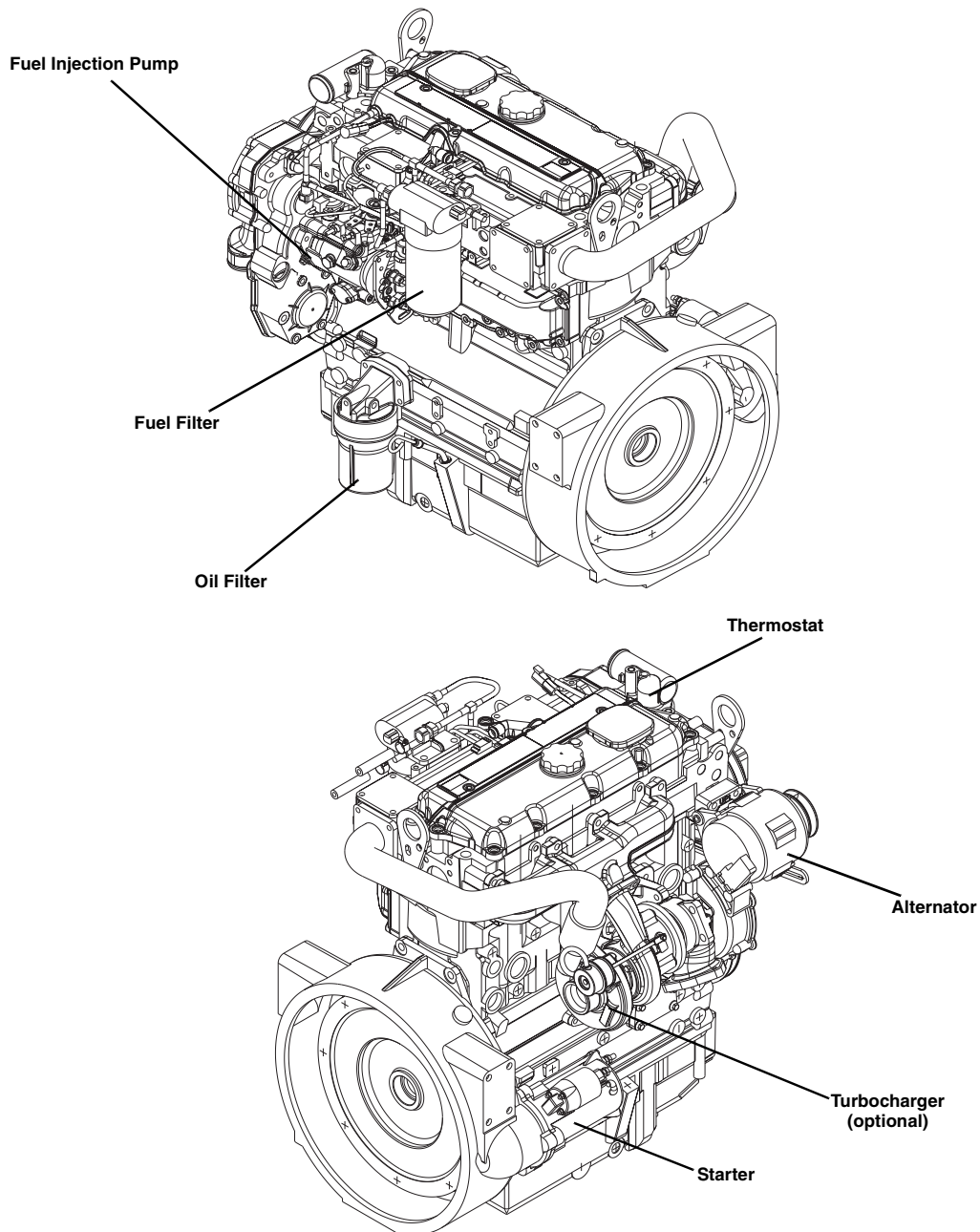
IMPORTANT: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. For assistance with comprehensive engine diagnosis, repair and component replacement, contact your local Perkins Service partner.*

A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 60° C (140° F). Extended light-load operation during the early life of the engine is not recommended. **DO NOT** run the engine at high, no-load speeds. **DO NOT** apply an overload to the engine.



7.1.2 Component Terminology

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the engine components. The following illustration identifies the components that are referred to throughout this section.



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7.2 ENGINE SERIAL NUMBER

The Perkins serial number is stamped on a plate which is secured to the engine block, near the fuel injector pump. Information contained in the serial number is required in correspondence with the engine manufacturer.

7.3 SPECIFICATIONS AND MAINTENANCE INFORMATION

For engine, coolant and oil specifications, and maintenance information, refer to Section 2, "General Information and Specifications."

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of the engine. Refer to your local Perkins Engine Distributor for assistance with comprehensive engine diagnosis, repair and component replacement.*

7.4 ENGINE COOLING SYSTEM

7.4.1 Radiator Pressure Cap

For a 99° C (210° F) system, use a 90 kPa (13 psi) radiator cap. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

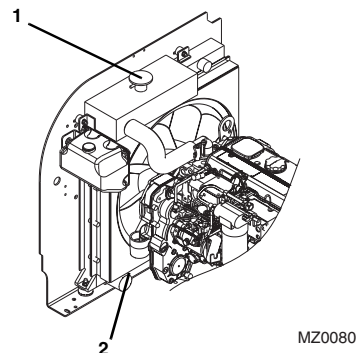
7.4.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If the engine seems to take a long time to warm up, the thermostat may be stuck in the open position and requires replacement.
- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Slowly turn the radiator cap (1) to the first stop and allow any pressure to escape. Remove the radiator cap.
6. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug (2) and slowly remove to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Replace the radiator drain plug.



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7. Remove the two capscrews securing the thermostat housing to the engine.
8. Remove the thermostat housing, old gasket and thermostat. Clean all gasket surfaces. **DO NOT** let any debris into the thermostat opening.

IMPORTANT: ALWAYS use the correct thermostat and install a new gasket. **NEVER** operate the engine without a thermostat, or engine damage will result.



b. Thermostat Installation

1. Install the engine thermostat, thermostat gasket and thermostat housing. Secure with the two capscrews. Torque to 24 Nm (18 lb-ft).
2. Connect the battery negative (-) cable to the battery negative (-) terminal.
3. Open the radiator cap, and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
4. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain, as necessary.
5. Close and secure the engine cover.

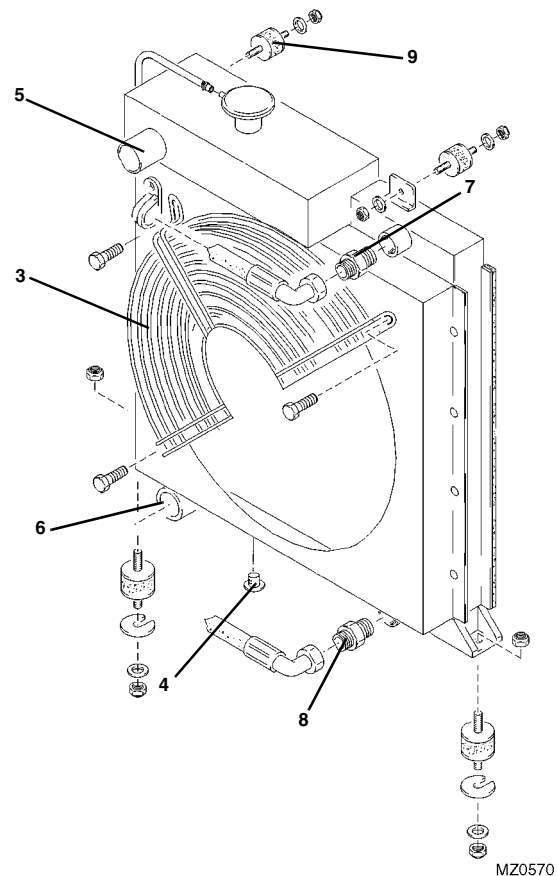
7.4.3 Radiator/Oil Cooler and Coolant Heater Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Radiator/Oil Cooler Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the engine cover to ease removal of radiator/oil cooler.



6. If necessary, remove the windshield washer fluid reservoir.
7. On platform equipped 13M machines, remove the ERS control panel and bracket to gain access to radiator mounting points. Refer to Section 8.8.6, "ERS Control Valve Assembly."
8. Remove the radiator guard cover (3) and the engine belly pan.
9. Slowly turn the radiator cap to the first stop and allow any pressure to escape. Remove the radiator cap.
10. Place a suitable container beneath the radiator drain plug.
11. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain plug (4) and slowly remove to allow the coolant to drain. Transfer the coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Replace the radiator drain plug.
12. Loosen the radiator clamp on the top radiator hose (5). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or



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remove the hose from the engine. Inspect the hose, and replace if necessary.

13. Loosen clamp on the radiator return hose (6). Work the hose off the radiator. Position the hose out of the way to allow radiator removal, or remove the hose from the engine. Inspect the hose, and replace if necessary.
14. Disconnect and plug the transmission inlet (7) and outlet hoses (8) and cap the fittings on the oil cooler. Remove the hose from the engine. Inspect the hose, and replace if necessary.
15. Remove the four nuts and four washers from the radiator mounts (9).
16. Carefully lift the radiator/oil cooler out of the engine bay.

Note: If applicable the radiator can be removed with the radiator frame. Remove the five bolts holding the radiator frame to the machine frame and remove the radiator and radiator frame as one unit.

b. Radiator/Oil Cooler Installation

1. Install the isolator mounts to the bottom of the radiator. Insert radiator through the machine frame mounts and install the washers and new locknuts.
2. At the top of the radiator, install the isolator mounts. Install the washers and new locknuts on the back side of the weldment.
3. Be sure the engine fan has clearance in regard to the radiator. Install the radiator guard cover.
4. At the lower radiator return hose, and with the clamp installed over the hose, work the hose onto the radiator and tighten the clamp.
5. Uncap and connect the transmission inlet and outlet hoses to the radiator.
6. At the upper radiator hose, and with the clamp installed over the hose, work the hose onto the radiator, and tighten the clamp.
7. Open the radiator cap and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
8. On Platform equipped 13M machines, install the ERS control panel and bracket. Refer to Section 8.8.6, "ERS Control Valve Assembly."
9. Connect the battery negative (-) cable to the battery negative (-) terminal.
10. Run the engine to operating temperature. Visually check for leaks with the engine running. Check the coolant level in the overflow bottle and fill, or drain as necessary.
11. Install the engine cover.
12. Install the belly pan.
13. Close and secure the engine cover.

7.5 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9, "Electrical System."

7.6 FUEL SYSTEM

7.6.1 Diesel Fuel

Fuel represents a major portion of machine operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.

IMPORTANT: Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.

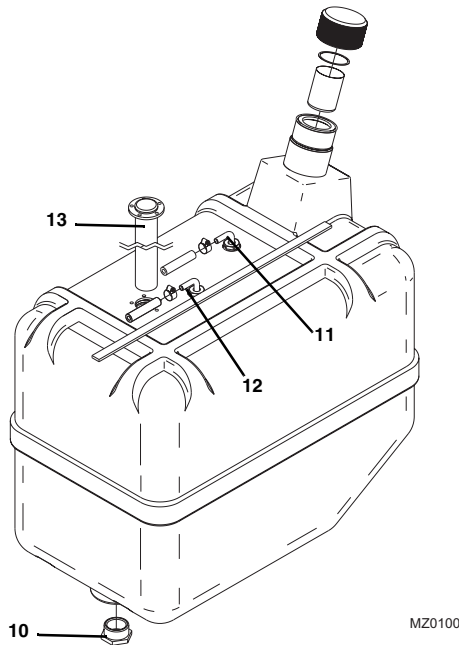
Inform the owner/operator of the machine to use #2 diesel fuel, unless ambient temperatures are below 0° C (32° F). When temperatures are below 0° C (32° F), a blend of #1 diesel and #2 diesel fuels (known as "winterized" #2 diesel) may be used.

Note: #1 diesel fuel may be used, however, fuel economy will be reduced.

Use a low-sulfur content fuel with a cloud point (the temperature at which wax crystals form in diesel fuel) at least 10° below the lowest expected fuel temperature. The viscosity of the fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.



Note: When using diesel fuel with a sulfur content below 1.3 percent, the filter change interval must be reduced by 75 hours. The use of fuel with a sulfur content above 1.3 percent is not recommended.



7.6.2 Fuel Tank

Note: The fuel tank is a one piece unit. It is located at the rear of the machine, between the frame. If it is determined that the fuel tank must be removed, the fuel must be drained before tank removal. Always dispose of fuel properly.

a. Fuel Tank Removal

1. Park the machine on a firm, level surface, level the machine, raise the boom to access the fuel tank, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Remove the boom. Refer to Section 3.3.1, "Boom Removal."
5. Disconnect the battery negative (-) cable at the battery negative (-) terminal.

Note: If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.

Note: Have a dry chemical (Class B) fire extinguisher near the work area.

6. Remove fuel tank drain plug (10), and drain fuel into an approved and suitable container. Dispose of fuel properly. Reinstall the fuel tank drain plug and torque to 26 Nm (19 lb-ft).
7. Loosen and remove the strap over the fuel tank and disconnect the fuel supply hose (11) and return line hose (12) from tank.
8. Disconnect fuel level sender (13) electrical connectors from the fuel level sender.
9. Remove screws securing fuel sender to the tank. Remove fuel sender from tank.
10. Lift the empty fuel tank from between the frame rails.

b. Disassembly

The fuel tank is a one-piece unit and cannot be disassembled. The fuel level indicator can be removed and reused on the new replacement tank.

c. Cleaning and Drying

If contaminated fuel or foreign material is in the tank, the tank can usually be cleaned.

Note: If a leak is suspected in the fuel tank, contact your local **JLG** distributor.

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the fuel or oil tank drain plug, and safely drain any fuel into a suitable container. Dispose of fuel properly.
3. Clean the fuel tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. Add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.



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d. Assembly

The fuel level indicator can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal.

e. Inspection

Note: If a leak is suspected in the fuel tank, contact your local JLG distributor.

1. Inspect the fuel tank thoroughly for any cracks, slices, leaks or other damage.
2. Plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 7-10 kPa (1-1.5 psi) of air pressure through the elbow. Check the tank for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

f. Fuel Tank Installation

1. Set fuel tank between frame rails.
2. Install the fuel tank strap over the fuel tank.
3. Install the fuel sender with new gasket into the fuel tank and secure with screws. Tighten to 5 Nm (3.6 lb-ft). **DO NOT** overtighten.
4. Connect the fuel supply hose and return line hose to the tank. Secure with clamps and tighten to 25 Nm (18 lb-ft)
5. Install the wire harness connections to the fuel sender.
6. Fill the fuel tank according to specifications. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
7. Check fuel tank for leaks.
8. Install the boom. Refer to Section 3.3.6, "Boom Installation."
9. Connect the battery negative (-) cable to the battery negative (-) terminal.
10. Close and secure the engine cover.

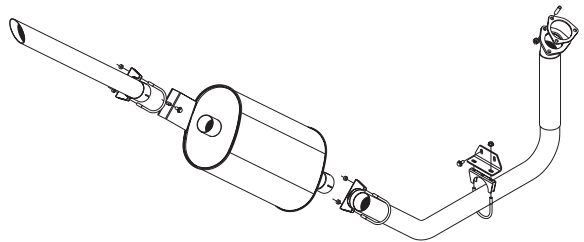
7.6.3 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate Operation & Safety Manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7.7 ENGINE EXHAUST SYSTEM

7.7.1 Exhaust System Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the belly pan.
6. Loosen and remove the mounting hardware for the exhaust pipe at the exhaust manifold. Replace the hardware if damaged.
7. Disconnect and remove the clamp attaching the exhaust pipe to the frame.
8. Disconnect and remove the clamp connecting the muffler to the exhaust pipe.
9. Disconnect and remove the clamp connecting the tail pipe to the muffler and remove the tail pipe.
10. Loosen and remove the two bolts at the front and one bolt at the rear of the muffler, and remove the muffler.



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7.7.2 Exhaust System Installation

Note: Keep all clamps loosened until entire exhaust system is in place.

1. Install the exhaust pipe with a new seal to the exhaust manifold.
2. Install the exhaust pipe clamp under the engine.
3. Install the muffler to the exhaust pipe and bolt the muffler to the side of the frame.
4. Install the clamp securing the muffler to the exhaust pipe.



5. Install the clamp securing the muffler to the tail pipe.
6. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
7. Connect the battery negative (-) cable to the battery negative (-) terminal.
8. Start engine and check for exhaust leaks at all exhaust connections. Adjust or repair as needed.
9. Install the belly pan.
10. Close and secure the engine cover.

7.8 AIR CLEANER ASSEMBLY



WARNING: NEVER run the engine with only the inner safety element installed.

IMPORTANT: Refer to the appropriate Operation & Safety Manual for the correct element change procedure.

7.8.1 Air Cleaner Assembly Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Disconnect the low pressure indicator wire connection on the air cleaner.
6. Remove the clamp securing the air intake elbow to the air cleaner assembly. Lift the air intake elbow off the air cleaner.
7. The reducing insert and the reinforcement ring should be removed along with the air intake tube.
8. Remove the clamp securing the air outlet elbow. Lift the air outlet elbow off the air cleaner.
9. Remove the two capscrews and ripp nuts securing the air cleaner mounting bracket to the air cleaner mounting plate. Remove the air cleaner assembly.

7.8.2 Air Cleaner Assembly Installation

Note: Apply Loctite® 242 threadlock to the capscrew threads before installation.

1. With the air cleaner assembly attached, install the air cleaner mounting bracket using capscrews and ripp nuts.
2. Place the loosened clamps over the air intake elbow along with the reducing insert and the reinforcement ring, and install elbow on the air cleaner assembly.
3. Place the loosened clamps over the air outlet elbow and install elbow on the air cleaner assembly.
4. Connect low pressure indicator wire connection.
5. Adjust and tighten both clamps before starting the machine.
6. Connect the battery negative (-) cable at the battery negative (-) terminal.

7.9 ENGINE REPLACEMENT

7.9.1 Engine Removal

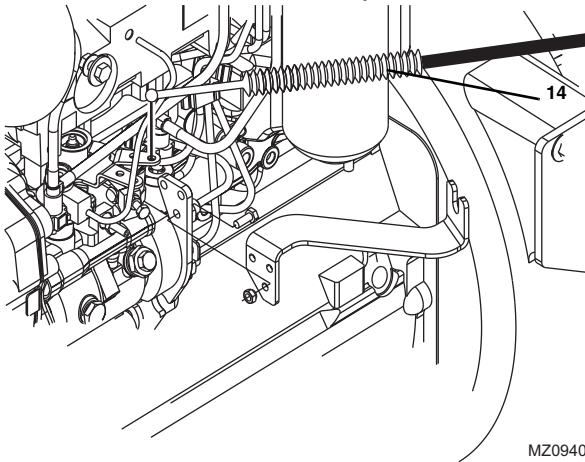
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the (+) positive and (-) negative battery cables and remove the battery.
5. Remove the engine cover, radiator guard plate and the engine belly pan.
6. On Platform equipped 13M machines, remove the ERS control and bracket. Refer to Section 8.8.6, "ERS Control Valve Assembly."
7. Drain and remove the radiator assembly. Refer to Section 7.4.3, "Radiator/Oil Cooler and Coolant Heater Replacement."
8. Remove the heater hoses attached to the engine.

Note: The engine harness is routed and attached to the engine using hold-down clamps and plastic wire ties at various places on the engine. Before removing engine, ensure that the harness has been completely separated (disconnected) from the engine. Move the harness clear of the engine, and with the help of an observer, ensure that engine clears the harness during removal.

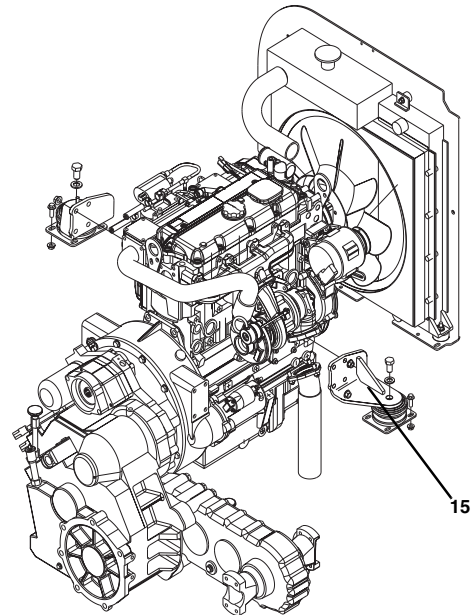


Engine: Perkins 1104-42 & 1104-42T

9. Label and disconnect all wire harness connections on the engine.
10. Unbolt and remove the hood latch plate. Mark the plate to help with hood adjustment when being reinstalled.
11. Unbolt the return hydraulic oil filter plate and leave in place.
12. Disconnect and cap the fuel inlet line at the fuel filter head.
13. Disconnect and cap the fuel return line from the fuel filter head.
14. Mark the location of the throttle cable (14) at the throttle cable mount. Loosen jam nuts and remove.



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15. Disconnect the throttle cable at the engine throttle lever.
16. Remove the exhaust pipe from the exhaust manifold. Refer to Section 7.7.1, "Exhaust System Removal."
17. Loosen the clamps on the sleeve reducer at the engine and on the air suction pipe.
18. Remove the air cleaner assembly. Refer to Section 7.8.1, "Air Cleaner Assembly Removal."
19. Remove the access plug from side of the engine bell housing. This will allow access to remove the eight bolts holding the flex plate to the engine flywheel.
20. Turn the engine over slowly by hand and align each of the eight flex plate bolts to be accessed. Remove them one at a time.
21. Secure the engine with a lifting strap or chain from the appropriate lifting points. Use a suitable hoist or overhead crane.
22. At the rear right engine mount (15), remove the bolt and washer. Repeat for the rear left engine mount.

23. Place a support or jack under the transmission to hold the transmission in place while engine is being removed.
24. Remove the ten bolts holding the transmission to the engine. Slightly lift and pull the engine out of the machine. Have an assistant ensure that the engine clears all frame components during removal.
25. Place engine on a flat, level surface.

7.9.2 Engine Disassembly, Inspection and Service

Engine disassembly, internal inspection, service, repair and assembly procedures are covered in the Perkins service manual. Several special engine service tools are required to properly service the engine. Contact your local Perkins Service partner for further information.

Note: If the engine is being replaced, there may be external components that will be required to be transferred from the original engine to the replacement engine depending upon who you purchase the new engine from and the configuration of your replacement engine. Refer to the appropriate Perkins user manual for detailed procedures that cover the transfer of original engine components to the replacement engine.



7.9.3 Engine Installation

1. Attach a lifting chain to the front and rear engine lift brackets, and lift engine clear of the ground.

Note: Apply Loctite® 242 threadlock to the engine mount bracket capscrew threads before installation.

2. Inspect the front engine mounting bracket isolator. Replace isolator if cracked or worn.
3. Install two guide studs in the bell housing holes.
4. Lift the engine and slowly push and lower into the engine bay. Have an assistant ensure that the engine clears all frame, hose and harness components during engine installation. Position engine brackets over the front frame mounts.
5. Push the engine towards the transmission aligning the guide studs and the torque converter shaft with the corresponding holes.
6. Push the engine against the transmission and install eight of the ten bolts and washers. Remove both guide studs and replace with the remaining two bolts and washers. Tighten bolts.
7. Torque the transmission bolts to 63 Nm (46 lb-ft) AFTER engine is lowered and secured with the front motor mount bolts installed and torqued.
8. Remove the support from under the transmission and lower the engine the remainder of the way onto the frame. Align the motor mount holes and install the bolts. Apply Loctite® 242 threadlock to the motor mount bolts and torque to 210 Nm (155 lb-ft).
9. Turn the engine over slowly by hand and align each of the eight flex plate bolts through the access plug in the bell housing. Install them one at a time. DO NOT fully tighten until all of the capscrews and locknuts are in place. Torque to 35-39 Nm (26-29 lb-ft). Replace access plug.
10. Install the exhaust pipe. Refer to Section 7.7.2, "Exhaust System Installation."
11. Install the complete air cleaner assembly. Refer to Section 7.8.2, "Air Cleaner Assembly Installation."
12. Install and tighten the jam nuts on the throttle cable at the throttle cable mount.
13. Connect the throttle cable at the engine throttle lever.
14. Connect the fuel inlet line to the fuel filter head.
15. Connect the fuel return line to the fuel filter head.
16. Connect all the labeled wire harness connections on the engine.
17. Install the hood latch plate. Align the mark on the plate to help with hood adjustment.

18. Secure the return hydraulic oil filter plate to the frame.
19. Install both heater hoses to the engine and tighten clamps.
20. Install the complete radiator assembly. Refer to Section 7.4.3, "Radiator/Oil Cooler and Coolant Heater Replacement."
21. Install the hose clamp on the bottom radiator hose and work onto the engine. Tighten the clamp.
22. Install the hose clamp on the top radiator hose and work onto the engine. Tighten the clamp.
23. Connect the transmission inlet and outlet hoses on the oil cooler. Install the clamp holding the top transmission cooler hose and the three bolts holding the fan screen.
24. On Platform equipped 13M machines, install the ERS control panel and bracket. Refer to Section 8.8.6, "ERS Control Valve Assembly."
25. Install the engine cover and adjust.
26. Install the battery and reconnect the (+) positive and (-) negative cables.
27. Open the radiator cap and fill the radiator completely with a 50/50 mixture of ethylene glycol and water. Replace and tighten the radiator cap. Add coolant to the overflow bottle until the bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in the cooling system.
28. Check that all hydraulic system, electrical system, cooling system, fuel system and exhaust system connections are correct and connected tightly.
29. From within the cab, lightly depress the throttle pedal to full-throttle position. As needed, adjust the limit-stop screw until it touches the pedal. Tighten the locknut to 13,6-14,1 Nm (120-125 lb-in).

Note: Have an assistant stand by with a Class B fire extinguisher.

30. Start the engine and run to normal operating temperature then shut off the engine. While the engine is cooling, check for leaks.
31. Allow the engine to cool. Check the radiator coolant level, and top off with a 50/50 mixture of ethylene glycol and water. Replace the radiator cap.
32. Check for leaks from the engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.



IMPORTANT: During the full throttle check:

- **DO NOT** operate any hydraulic function.
 - **DO NOT** steer or apply any pressure to the steering wheel.
 - Keep the transmission in (N) NEUTRAL.
33. Obtain and connect an appropriate engine analyzer or tachometer. Check the engine rpm at full throttle. If the rpm is not 2340 ± 50 rpm, readjust the throttle limit-stop screw at the throttle pedal within the cab.
 34. Purge the hydraulic system of air by operating all boom functions through their entire range of motion several times. Check the hydraulic oil level.
 35. Check for proper operation of all components.
 36. Turn the engine off.
 37. Install the engine belly pan.
 38. Close and secure the engine cover.

7.10 ENGINE DRIVE PLATE

7.10.1 Drive Plate Removal

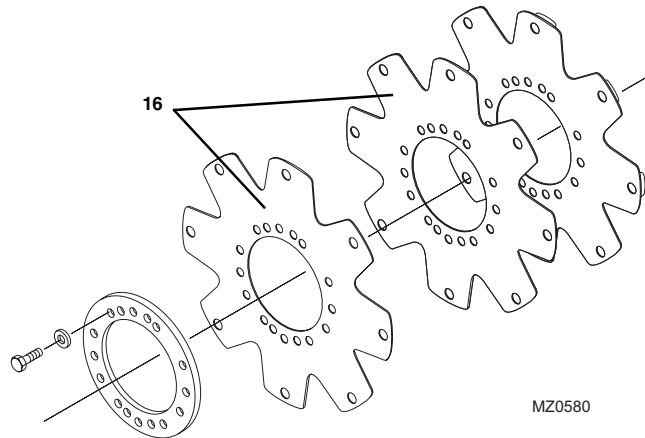
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.

Note: In order to remove the engine drive plates, the engine and transmission must be separated.

5. Refer to Section 6.5.1, "Transmission Removal," or Section 7.9.1, "Engine Removal."
6. Remove the eight bolts holding the drive plates (16) to the flywheel.
7. With the drive plates and torque converter removed, loosen and remove the six bolts and six lock washers holding the three drive plates to the torque converter.
8. Replace all three drive plates if damaged

7.10.2 Drive Plate Installation

1. Install the three new drive plates on the torque converter and torque the six bolts with lock washers to 35-39 Nm (26-29 lb-ft).
2. Mount the drive plate/converter assembly to the transmission.
3. Refer to Section 6.5.3, "Transmission Installation," or Section 7.9.3, "Engine Installation," for the remainder of the installation.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.





7.11 TROUBLESHOOTING

Trouble	Possible Causes (see key, below)
Low Cranking Power	1, 2, 3, 4
Will Not Start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult Starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33, 61, 63
Lack of Power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33, 61, 63
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive Fuel Consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33, 63
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33, 61, 63
Blue/White Exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56, 62
Low Oil Pressure	4, 36, 37, 38, 39, 40, 42, 43, 44, 58
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 59
Erratic Running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 59
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 48, 49
High Oil Pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive Crankcase Pressure	25, 31, 33, 34, 45, 55, 60
Poor Compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 59
Starts and Stops	10, 11, 12

Key to Possible Causes

- | | | |
|---|--|--|
| 1. Battery charge low | 21. Blocked fuel tank vent | 43. Faulty suction pipe |
| 2. Bad electrical connection | 22. Incorrect grade of fuel | 44. Restricted oil filter |
| 3. Faulty starter motor | 23. Sticking throttle or restricted movement | 45. Piston seizure/pick up |
| 4. Incorrect grade of lubricating oil | 24. Exhaust pipe restriction | 46. Incorrect piston height |
| 5. Low cranking speed | 25. Leaking cylinder head gasket | 47. Damaged fan |
| 6. Fuel tank empty | 26. Overheating | 48. Faulty engine mounting |
| 7. Faulty stop control operation | 27. Cold running | 49. Incorrectly aligned flywheel housing or incorrectly aligned flywheel |
| 8. Fuel inlet restricted | 28. Incorrect tappet adjustment | 50. Faulty thermostat |
| 9. Faulty fuel lift pump | 29. Sticking valves | 51. Restriction in water jacket |
| 10. Clogged fuel filter | 30. Incorrect high pressure pipes | 52. Loose fan belt |
| 11. Restricted air cleaner | 31. Worn cylinder bores | 53. Restricted radiator |
| 12. Air in fuel system | 32. Pitted valves and seats | 54. Faulty water pump |
| 13. Faulty fuel injection pump | 33. Broken, worn or sticking piston ring(s) | 55. Restricted breather pipe |
| 14. Faulty fuel injectors or incorrect type | 34. Worn valve stems and guides | 56. Damaged valve stem oil deflectors (if fitted) |
| 15. Incorrect use of cold start equipment | 35. Restricted air cleaner | 57. Coolant level too low |
| 16. Faulty cold start equipment | 36. Worn or damaged bearings | 58. Blocked sump strainer |
| 17. Broken fuel injection pump drive | 37. Insufficient oil in sump | 59. Broken valve spring |
| 18. Incorrect fuel pump timing | 38. Inaccurate gauge | 60. Exhauster or vacuum pipe leak |
| 19. Incorrect valve timing | 39. Oil pump worn | 61. Turbo impeller damaged or dirty |
| 20. Poor compression | 40. Pressure relief valve sticking open | 62. Turbo lubricating oil seal leak |
| | 41. Pressure relief valve sticking closed | 63. Induction system leaks |
| | 42. Broken relief valve spring | |



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Section 8

Hydraulic System

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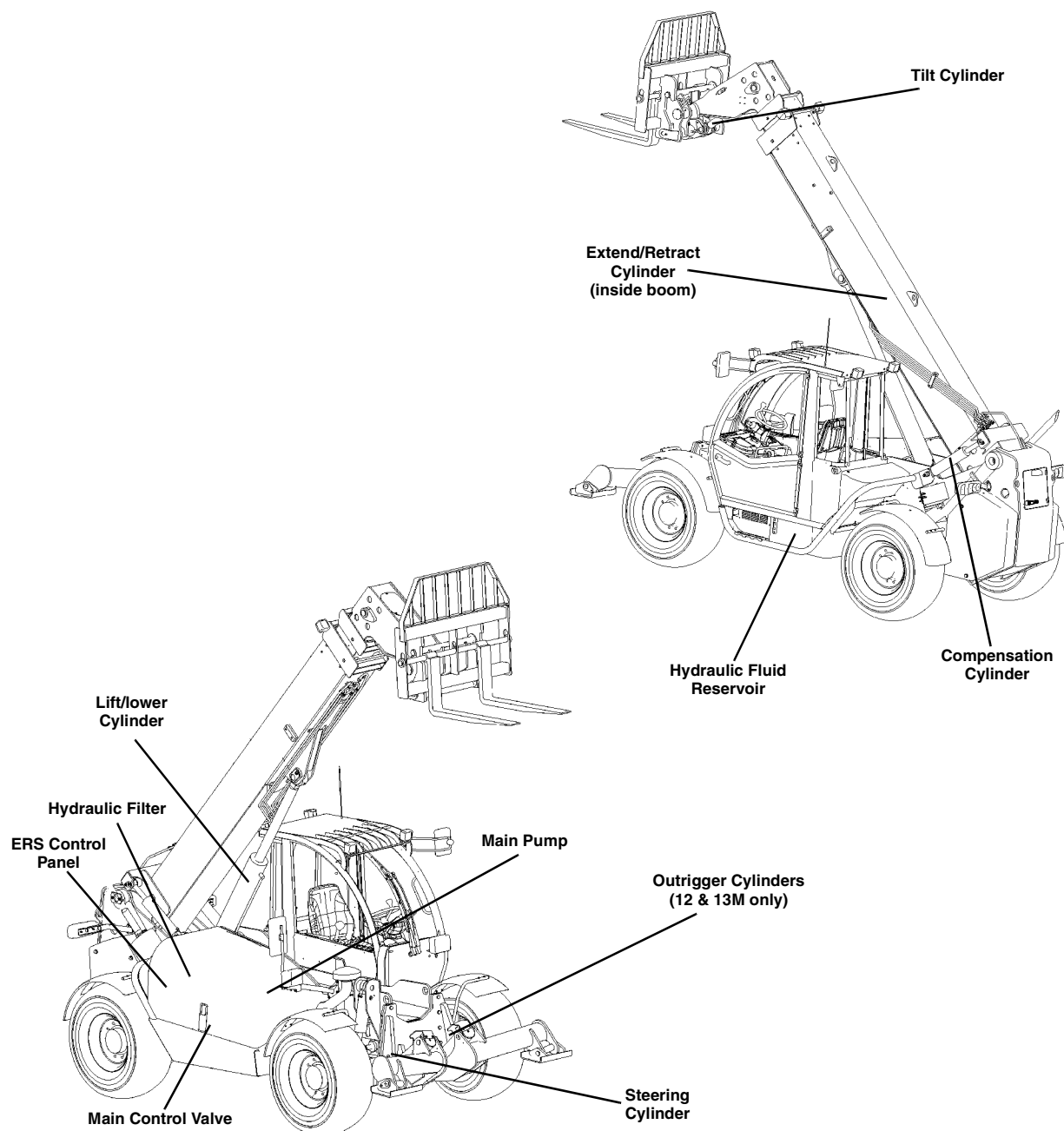
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Hydraulic System

8.1 HYDRAULIC COMPONENT TERMINOLOGY

To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the machine. The following illustration identifies the components that are referred to throughout this section.





8.2 SAFETY INFORMATION



WARNING: **DO NOT** service the machine without following all safety precautions as outlined in Section 1, "Safety Practices," of this manual. Failure to follow the safety practices may result in death or serious injury.

Petroleum-based hydraulic fluids are used in this machine. The temperature of hydraulic fluid increases during the operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present.

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

Whenever you disconnect a hydraulic line, coupler, fitting or other component, slowly and cautiously loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also.

8.3 HYDRAULIC PRESSURE DIAGNOSIS

JLG Parts Department has a kit available to use for hydraulic system maintenance and troubleshooting: the JLG Pressure Test Kit. The kit is in a durable polyethylene carrying case for demanding field service conditions.

Pressure Test Kit

The hydraulic pressure test kit is used to pressure test the various hydraulic components in the hydraulic system.

The kit includes:

- Gauges for testing high and low pressure circuits
- Fittings, couplers and hoses
- Durable carrying case

Contact your local **JLG** distributor for ordering information.

Part Number	Description	Approximate Weight	Price and Availability
70000652	Hydraulic Pressure Test Kit	10 lbs.	Consult Factory
70000101	Digital Hydraulic Pressure Test Kit	7 lbs.	Consult Factory



Hydraulic System

8.4 HYDRAULIC CIRCUITS

This section covers the hydraulic circuits and includes listings for all hydraulic function pressures, where and how to check those pressures.

Electrical and hydraulic functions are often related. Verify that the electrical components of the circuit are functioning properly whenever troubleshooting the hydraulic circuit.

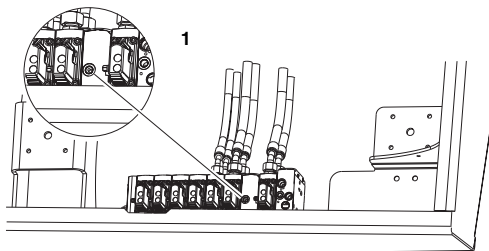
Always check the following before beginning to troubleshoot a circuit that is not functioning correctly.

1. Check the hydraulic oil level in the reservoir. Oil level should be at the middle of the sight glass with all cylinders retracted.
2. Check hoses, tubes, fittings and other hydraulic components for leaks, bends, kinks, interference, etc.
3. Check for air in the hydraulic system. Erratic machine performance and/or spongy cylinder operation are signs of air in the hydraulic system.
4. If air in the hydraulic system is suspected, you will hear air leakage when hydraulic fittings are loosened and see air bubbles in the hydraulic fluid.
5. Loose fittings, faulty o-rings or seals, trapped oil, leaks, system opened for service, etc., can cause air in the system. Determine what is causing air to enter the system and correct it. Bleed air from the system.

8.4.1 Checking Function Pressures

All hydraulic system function pressures can be checked at one location. A digital pressure gauge is recommended.

1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 345 bar (5000 psi) gauge to the test port (1) located at the top right corner of the main control valve.



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3. Start the machine, run the engine at full throttle and bottom the boom in function.

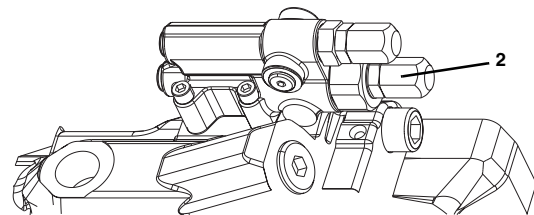
Note: It is possible to see maximum system pressure by activating and bottoming any of the hydraulic functions.

4. With the engine running at full throttle and the hydraulic function bottomed, the gauge should read 250 bar (3625 psi) \pm 5 bar (70 psi).

8.4.2 Adjusting Hydraulic Pressure

There is only one adjustment to set the main hydraulic pressure.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Open the engine cover.
3. Remove the cap on the bottom relief on the pilot valve at the main hydraulic pump located at the end of the transmission.



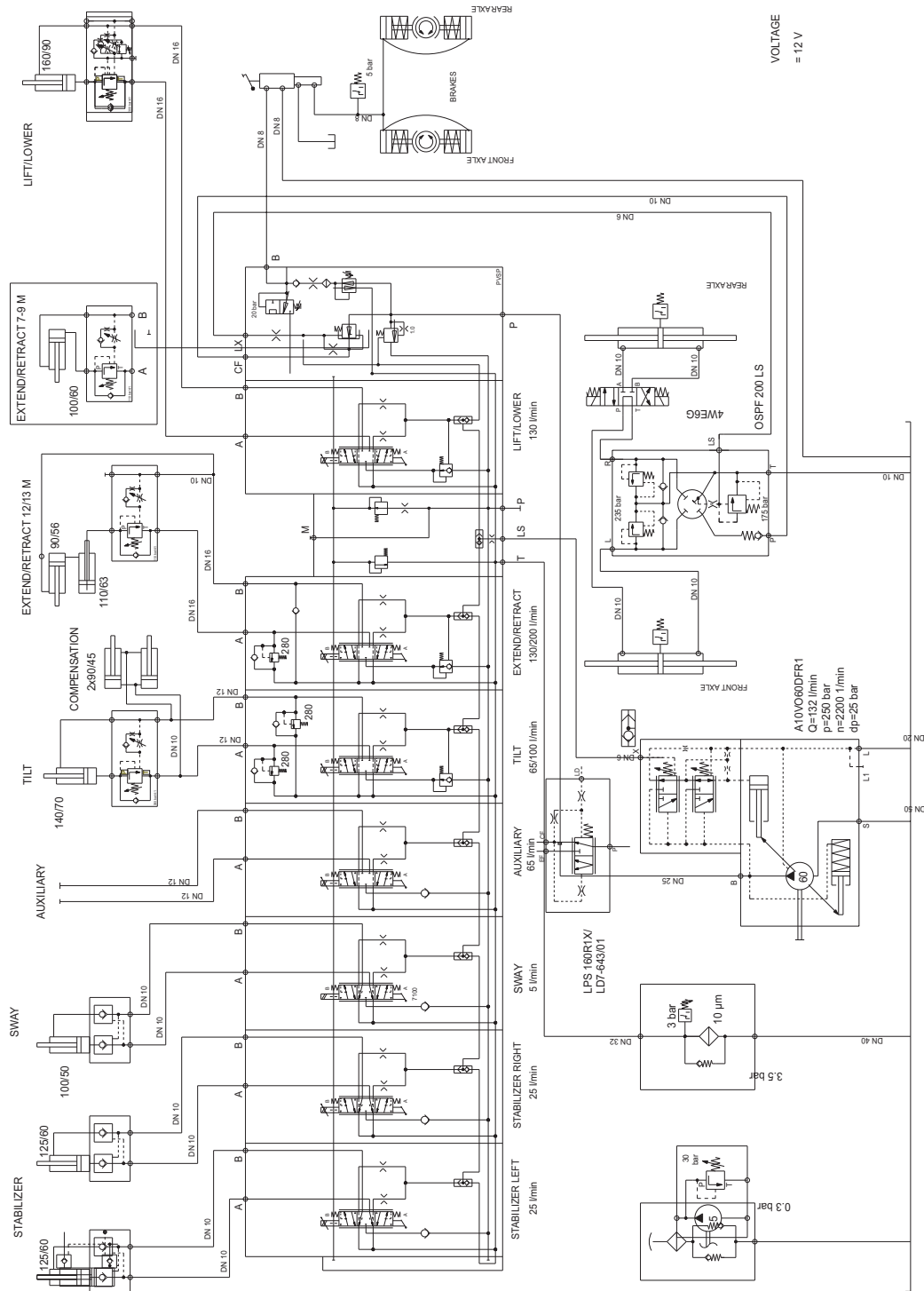
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4. Start the machine and loosen the jam nut on the relief and using an allen wrench; turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure. Set the pressure to 250 bar (3625 psi) \pm 5 bar (70 psi) at full throttle.
5. Tighten the jam nut and recheck the pressure at full throttle. If the reading is within specification, shut the machine off, install the safety cap and remove the gauge from the test port.
6. If the proper pressure cannot be set, refer to Section 8.5, "Hydraulic Schematics," or Section 9.5, "Electrical System Schematics," to help troubleshoot the problem.



8.5 HYDRAULIC SCHEMATICS

STANDARD MACHINE

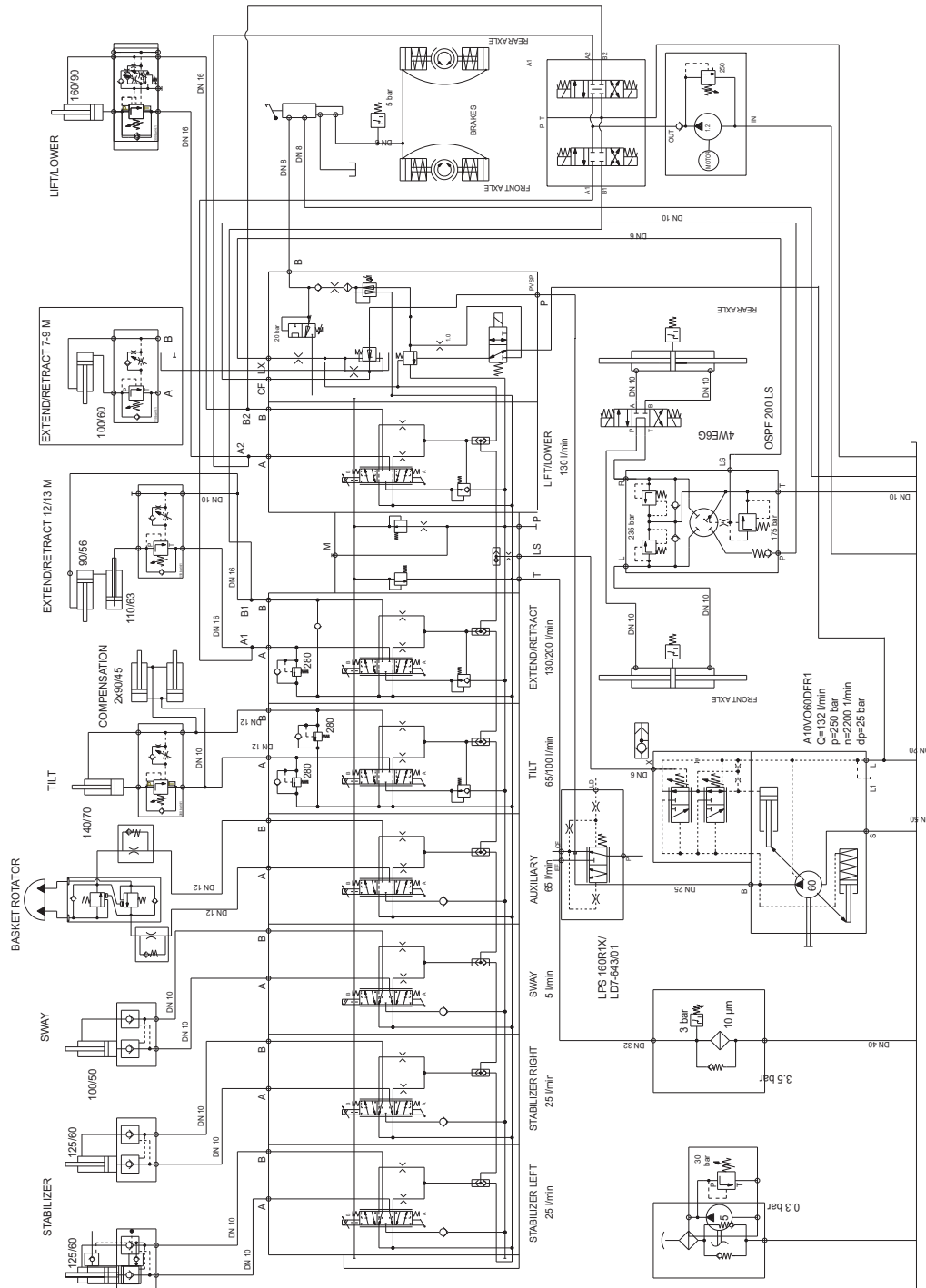


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8.5 Hydraulic Schematics (Continued)

SMART BASKET OPTION

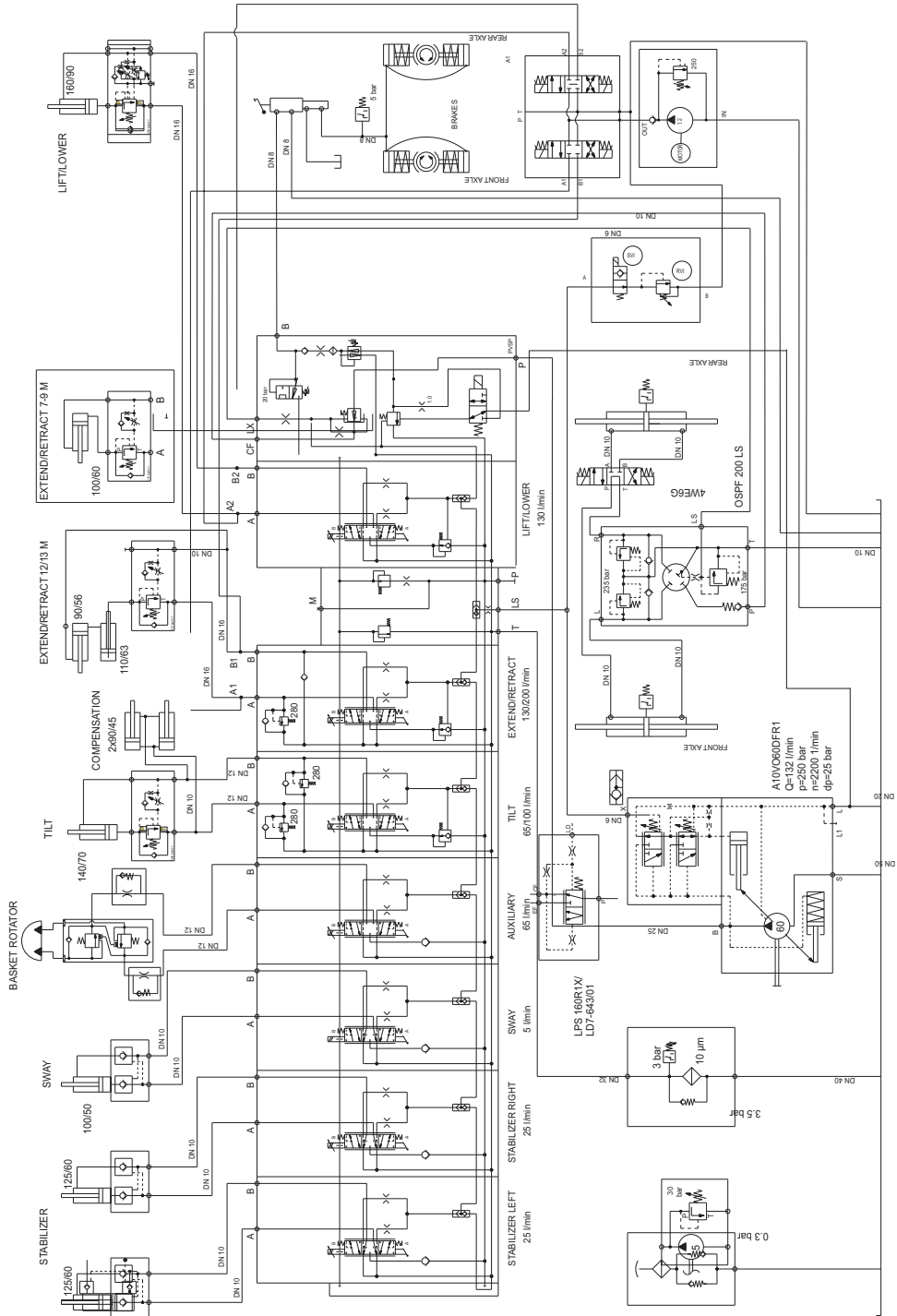


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8.5 Hydraulic Schematics (Continued)

AUSTRALIAN SMART BASKET OPTION

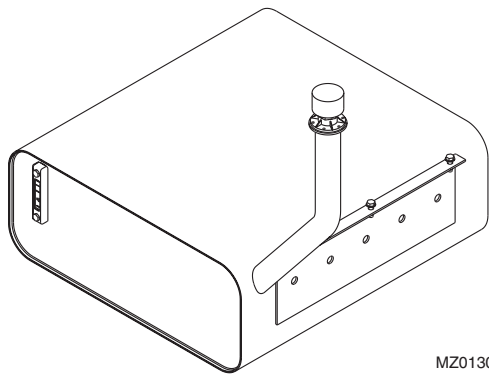




8.6 HYDRAULIC RESERVOIR

The hydraulic reservoir is a one piece unit. It is located under the rear of the machine cab. Occasionally, fluid may seep, leak or be more forcefully expelled from the breather when system pressure exceeds the rating of the filter head or breather. If the return filter becomes plugged, the return hydraulic oil will bypass the filter when pressure reaches 1,7 bar (25 psi) and return to the reservoir unfiltered.

Carefully examine fluid seepage or leaks from the hydraulic reservoir to determine the exact cause. Clean the reservoir and note where any seepage occurs.



8.6.1 Hydraulic Oil Reservoir Draining

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Open the filler cap on the hydraulic oil reservoir. Remove the drain plug at the bottom of the hydraulic oil reservoir.
6. Transfer the used hydraulic oil into a suitable, covered container, and label as "Used Oil". Dispose of used oil at an approved recycling facility. Clean and reinstall the drain plug.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.

8.6.2 Hydraulic Oil Reservoir Filling

1. Be sure reservoir is clean and free of all debris.
2. Install a new hydraulic oil filter.
3. Fill the reservoir with Mobilfluid 424® ISO Grade 46 oil. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

8.6.3 Hydraulic Oil Reservoir Removal/Installation

If it is determined that the hydraulic oil reservoir must be removed, the hydraulic oil must be drained before the reservoir is removed. Always dispose of hydraulic oil properly.

a. Reservoir Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Drain the hydraulic oil reservoir. Refer to Section 8.6.1, "Hydraulic Oil Reservoir Draining."
6. Loosen the clamps and remove and cap the suction and return hoses on the hydraulic oil reservoir.
7. Plug and cap the fittings on the hydraulic oil reservoir.
8. Support the hydraulic oil reservoir from the bottom and remove the six bolts, washers and nuts.
9. Carefully lower the reservoir to the ground.

b. Disassembly

The hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The hydraulic oil level sight-glass and hydraulic oil filler cap can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.



c. Cleaning and Drying

If contaminated hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

To clean the hydraulic oil reservoir:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Clean the hydraulic oil reservoir with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.

d. Inspection

Note: If a leak is suspected in the hydraulic oil reservoir, contact JLG Service Department.

1. Inspect the hydraulic oil reservoir thoroughly for any cracks, slices, leaks or other damage.
2. With the hydraulic oil reservoir removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 0,06-0,10 bar (1-1.5 psi) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

e. Reservoir Installation

1. Lift the hydraulic oil reservoir into place and install the six bolts, washers and nuts.
2. Uncap and connect the suction hose and return hose. Tighten both clamps.
3. Uncap and connect the four small return hoses to the fittings on the hydraulic oil reservoir.
4. Install the hydraulic fluid level sight-glass using special designed and drilled capscrews and gaskets.
5. Install hydraulic filter neck components and secure.
6. Fill the hydraulic oil reservoir according to specifications. Refer to Section 2.4, "Fluids, Lubricants and Capacities."
7. Check the hydraulic oil reservoir for leaks.
8. Connect the battery negative (-) cable to the battery negative (-) terminal.
9. Close and secure the engine cover.

8.7 HYDRAULIC SYSTEM PUMP

8.7.1 Pump Description

For internal service instructions contact your local JLG distributor.

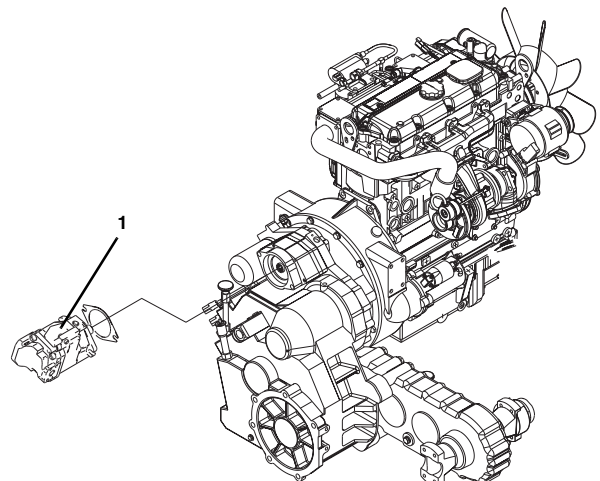
8.7.2 Pump Failure Analysis

The implement pump is the "heart" of the hydraulic system, and whenever there is a problem in the system, the pump often is blamed. However, implement pump failure is seldom due to failure of pump components. Pump failure usually indicates another problem in the hydraulic system.

According to pump manufacturer statistics, 90-95 percent of pump failures are due to one or more of the following causes:

- Aeration
- Cavitation
- Contamination
- Excessive Heat
- Over-Pressurization
- Improper Fluid

In the event of pump failure, investigate further to determine the cause of the problem.



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Hydraulic System

8.7.3 Pump Replacement

a. Pump Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Relieve any trapped pressure in the hydraulic system by using the lever (supplied in the tool box) or a 9mm wrench and move the double nut on the side of the actuator module on each valve section back and forth.
6. Thoroughly clean the pump and surrounding area, including all hoses and fittings before proceeding.

Note: Cap all hoses as you remove them to prevent unnecessary fluid spillage.

7. Remove the four bolts and four lockwashers securing the flange halves to the pump. Remove the inlet hose and o-ring.

Note: Before removing any fittings from the pump, note their orientation to ensure correct installation.

8. Remove the four bolts and four lockwashers securing the flange halves to the pump. Remove the outlet hose and o-ring.
9. Disconnect the case drain hose from the fitting. Disconnect the load sense line.
10. Remove the two bolts and two lockwashers securing the pump to the transmission. Remove the gasket located between the transmission and the pump. Wipe up any hydraulic oil spillage.

Note: DO NOT disassemble the implement pump. The pump is pre-set from the manufacturer. Any adjustments or repairs performed by anyone other than an authorized dealer could void the warranty.

b. Pump Installation

1. While the pump is still on the bench, install all fittings, except the outlet hose fitting, orienting them as noted during removal.
2. Apply Loctite® 573 on the metal seal of the pump and place into position on the transmission. Align the pump shaft with the internal transmission gear, so that the machined teeth mesh together.
3. Align the bolt holes with the pump mount holes. Secure the pump to the transmission with the two bolts and washers. Torque to 115 Nm (85 lb-ft).
4. If necessary, slide the T-bolt band clamp onto the pump inlet hose. Secure the hoses to the hydraulic reservoir outlet connection with the T-bolt band clamp.
5. Place a new oiled o-ring into position over the pump opening. Secure the inlet hose with two flange halves, four lockwashers and four bolts.
6. Connect the load sense line to the fitting.
7. Place a new, oiled o-ring into position over the pump opening. Secure the outlet hose with two flange halves, four lockwashers and four bolts.
8. Prime the pump by filling the case drain port with fresh, filtered hydraulic oil from a clean container before installing the case drain connector and hoses.
9. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
10. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
11. Inspect for leaks and check all fluid levels. The hydraulic reservoir oil level must be to the middle of the sight gauge.
12. Connect the battery negative (-) cable to the battery negative (-) terminal.
13. Close and secure the engine cover.

c. Pump Test

Refer to Section 8.4.2, "Adjusting Hydraulic Pressure."

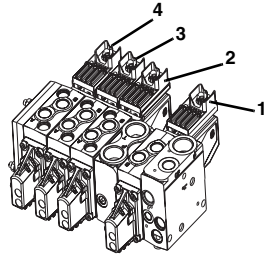


8.8 VALVES AND MANIFOLDS

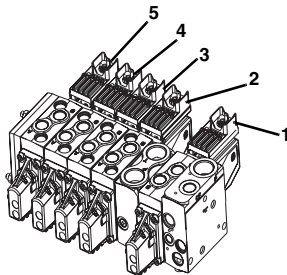
8.8.1 Main Control Valve

The main control valve is mounted on the side rail in the engine compartment.

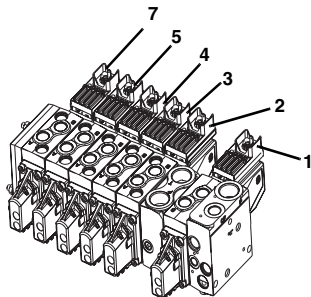
4 SECTION VALVE



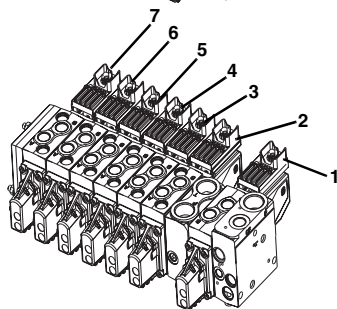
5 SECTION VALVE



6 SECTION VALVE



7 SECTION VALVE

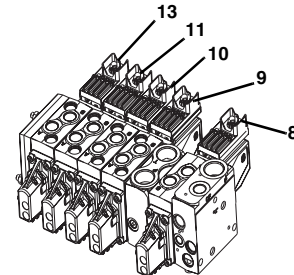


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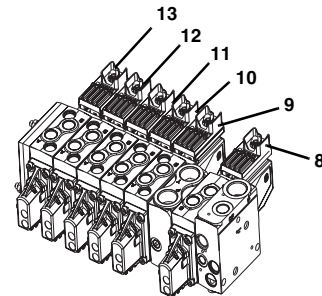
The main control valve assembly consists of working sections with their own valve assemblies, each providing a specific hydraulic function. Those functions are: lift/lower (1), extend/retract (2), tilt (3), auxiliary (4), sway (5), outrigger right (6) and outrigger left (7).

Note: The 7M Agricultural Option has two separate options for the main control valve. The functions are: lift/lower (8), extend/retract (9), tilt (10), auxiliary (11), sway (12) and auxiliary rear (13).

5 SECTION VALVE



6 SECTION VALVE



MZ1770

a. Main Control Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. With the engine OFF, relieve any trapped pressure in the hydraulic system by using the lever (supplied in the tool box) or a 9mm wrench and move the double nut on the side of the actuator module on each valve section back and forth.
5. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
6. Place a suitable container to catch hydraulic fluid drainage beneath the frame.
7. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.



Hydraulic System

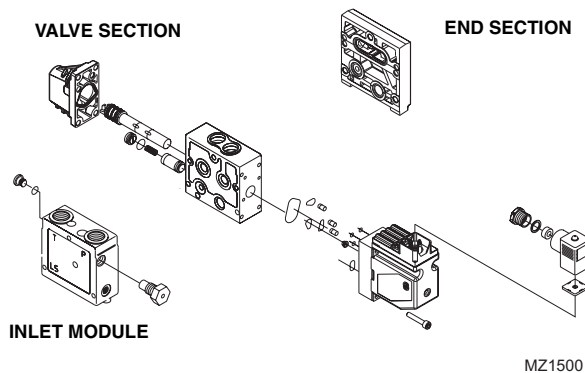
- Support the valve and remove the four bolts securing the main control valve bracket to the frame.
- Remove the main control valve and bracket from the frame and remove the four bolts holding the mounting bracket to the valve.

b. Main Control Valve Disassembly

- To disassemble the individual sections of the main control valve, remove the nuts and from the end of the tie rod. Pull the tie rods out through the sections.
- Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

IMPORTANT: DO NOT adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in the affected circuit, requiring recalibration or a new relief valve.



Disassemble each Valve Section

- Carefully separate the load sense outlet section from the extend/retract section.
- Remove the o-rings from between the two sections.
- Carefully separate each remaining section being careful not to lose the load sense shuttle ball.
- Remove both end caps from each end of the valve sections then remove each control spool.
- Remove any check valves, compensator valves, anti-cavitation valves or shock valves from each individual valve section if equipped.
- Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as trichlorethylene, before continuing. Blow dry.

d. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.

e. Main Control Valve Assembly

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

Assemble each Valve Section

- Reassemble any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve sections if equipped.
- Install the control spool being careful not to nick or scratch the valve section bore or the control spool.
- Install the end caps on each end of the valve section.

Assemble the Main Control Valve.

- Place all three tie rods with the washers and nuts through the end main control valve section.
- Stand the end main control valve section on end.
- Install proper o-rings and load sense shuttle on the inner face of the end main control valve section. Align the extend/retract section over the three tie rods and slide onto the end main control valve section.
- Using proper o-rings and load sense shuttle, repeat step three for the remaining sections.
- Install the washers and nuts on the tie rods and torque to 22 Nm (195 lb-in).

f. Main Control Valve Installation

- Loosely install the four main control valve mounting bolts through bracket on the inside rail of the engine bay.
- Install the main control valve onto the bracket, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts.
- Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.



4. Use new oiled o-rings as required. Uncap and connect all hoses, clamps, etc. to the main control valve.
5. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
6. Connect the battery negative (-) cable to the battery negative (-) terminal.
7. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
8. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.
9. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
10. Close and secure the engine cover.

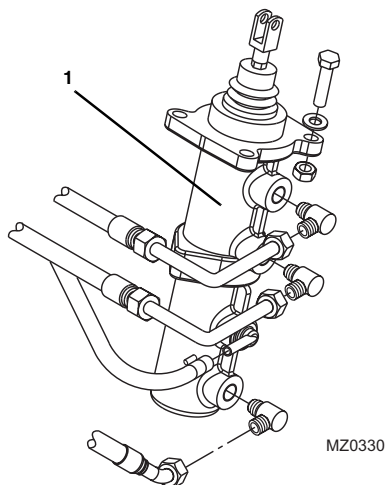
g. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.4.1, "Checking Function Pressures."

8.8.2 Service Brake Valve

The service brake valve is at the base of the steering column support, concealed by the lower dash cover.

The service brakes themselves are part of the axles (the park brake is part of the front axle only). Refer to Section 5, "Axles, Drive Shafts, Wheels and Tires," for further information.



a. Service Brake Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Remove the necessary dash panels.
6. Label, disconnect and cap all hydraulic hoses and fittings on the side of the service brake valve (1).
7. Disconnect the pin holding the yoke to the brake pedal arm.
8. Remove the four capscrews, four nuts and four lockwashers mounting the service brake valve to the steering column support.

Note: *DO NOT* disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.

b. Service Brake Valve Installation

1. Install the service brake valve with the lockwashers and capscrews to mount the brake valve to the steering column support.
2. Align the yoke on the brake valve with the brake pedal arm. Insert the pin and clip into place being sure there is a small amount of play between the pedal and the brake plunger.

Note: *ALWAYS* replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

3. Use new oiled o-rings as required. Reattach and secure all valves, hoses, clamps, etc.
4. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.



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6. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.
7. Inspect the service brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

8. Close and secure the engine cover.

8.8.3 Brake Test

Carefully bleed the brake lines as soon as the brake valve is installed in the machine. Air in the system will not allow the brakes to apply properly. There are two brake bleeder locations on each axle. Work with an assistant to perform this procedure.

1. Place the transmission control lever in (N) NEUTRAL, engage the park brake, and start the engine.
2. Remove the plastic cap from the front brake bleeder. Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.
3. **DO NOT** open the brake bleeder without holding the tubing firmly on the bleeder. There is a pressure at the brakes. Carefully open the bleeder with a wrench. Have the assistant depress the brake pedal. Close the brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. remove the tubing from the brake bleeder.
4. Repeat Steps 2 and 3 for the remaining brake bleeders.
5. Install a vacuum pump on the brake reservoir and remove the remainder of the trapped air from the brake system.
6. Check brake fluid level and add if necessary using ATF fluid.
7. Conduct a pressure and function check of the service brake. Refer to Section 8.3, "Hydraulic Pressure Diagnosis."

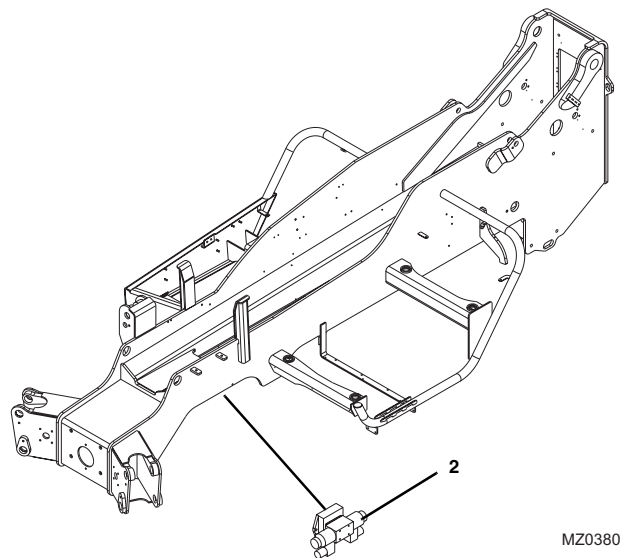
8.8.4 Steering Orbitrol Valve

Refer to Section 4.3.1, "Steering Column and Orbitrol Valve," for details.

8.8.5 Steer Select Valve

The machine can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve controls the direction of hydraulic fluid flow to the steering cylinder mounted on each axle. The steer select valve is attached to a mounting plate inside the frame near the left front corner of the cab.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. The housing of the steer select valve is not serviceable and must be replaced if defective.



a. Steer Select Manifold and Valve Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Disconnect the battery negative (-) cable from the battery negative (-) terminal.
5. Label, disconnect and cap all hydraulic hoses and fittings connected to the steering select valve.
6. Disconnect all wire terminal leads attached to the steering select valve.
7. Remove the two bolts holding the steer select valve to the mounting plate on the frame.



- Remove the steer select manifold with the attached steer select valve (2) from the machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Valve and Manifold Disassembly, Cleaning, Inspection and Assembly

- Place the steer select assembly on a suitable work surface.
- Separate the steer select valve from the manifold by removing the four socket head capscrews. Discard the four o-rings.
- Remove the solenoid valves and cartridges from the steer select housing.
- Clean all components with a suitable cleaner before inspection.
- Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
- Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold DO NOT display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.

- Install the solenoid valves and cartridges in the steer select housing.
- Attach the steer select valve to the manifold using four new, oiled o-rings and the four socket head capscrews.

c. Steer Select Manifold and Valve Installation

- Install the steer select valve to the mounting plate under the left side of the frame using the two bolts.
- Uncap and connect the previously labeled hydraulic hoses and fittings to the steer select valve.
- Connect all previously labeled wire terminal leads to the steer select valve.
- Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.

- Connect the battery negative (-) cable to the battery negative (-) terminal.
- Start the engine and run at approximately 1/3-1/2 throttle for about one minute, without moving the machine or operating any hydraulic functions.
- Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.

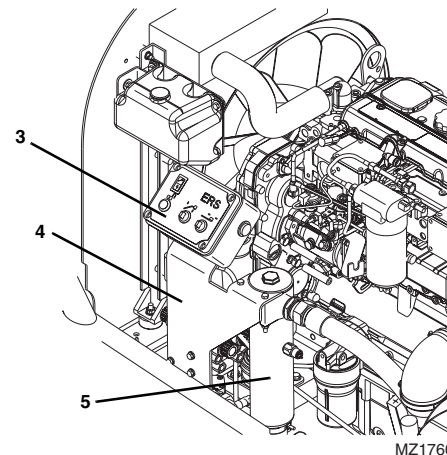
- Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
- Close and secure the engine cover.

d. Steering Test

- Conduct a pressure check of the steering hydraulic circuit at the test port on the implement pump. Refer to Section 8.4.2, "Adjusting Hydraulic Pressure."
- Check each steering mode for proper function.

8.8.6 ERS Control Valve Assembly

The ERS Control Panel is only included on 13M Platform machines. The control panel is located in the engine compartment.



a. ERS Control Valve Assembly Removal

- Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
- Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
- Open the engine cover. Allow the system fluids to cool.



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4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Label and disconnect the electrical connections attached to the ERS control panel (3).
6. Remove the four bolts that attach the control panel face plate to the control panel body.
7. Remove the two capscrews that attach the control panel body to the control panel bracket (4).
8. Label, disconnect and cap all hydraulic hoses attached to the ERS control valve assembly.
9. Label, disconnect and cap the hydraulic hoses attached to the hydraulic filter (5).
10. On Australian Platform machines, label, disconnect and cap the hydraulic hoses attached to the 2 by 2 valve. Remove the two mounting capscrews securing the 2 by 2 valve. Remove the 2 by 2 valve from the engine compartment.
11. Remove the ERS control valve assembly mounting hardware. Remove the ERS control valve assembly from the engine compartment.
12. Remove the hydraulic filter from the engine compartment.
13. Loosen, but do not remove the two bolts on the left side of the main control valve bracket. Remove the two bolts in the center of the control valve bracket.
14. Slide the control valve assembly bracket to the left to release the bracket from the engine compartment.

b. ERS Control Valve Assembly Installation

1. Slide the control valve assembly bracket into position by guiding the bracket notches around the main control valve bracket mounting bolts.
2. Install the two bolts in the center of the control valve bracket. Tighten the two bolts on the main control valve bracket.
3. Install the hydraulic filter to its original position.
4. Position the ERS control valve assembly to its original orientation and secure with the same mounting hardware.
5. On Australian machines, secure the 2 by 2 valve to the control valve bracket. Uncap and reconnect the hydraulic hoses to the 2 by 2 valve.
6. Uncap and reconnect the hydraulic hoses to the hydraulic filter and the ERS control valve.
7. Install the ERS control panel to the control panel bracket with two capscrews.
8. Install the face plate to the control panel with four capscrews.
9. Connect the previously labeled electrical connections to the ERS control panel.
10. Connect the battery negative (-) cable to the battery negative (-) terminal.
11. Close and secure the engine cover.

8.9 HYDRAULIC CYLINDERS

8.9.1 General Cylinder Removal Instructions

1. Remove any attachment from the machine. Park the machine on a firm, level surface, allowing sufficient workspace. Level the machine, place the transmission control lever in (N) NEUTRAL, engage the park brake, shut the engine OFF and block the wheels.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the system fluids to cool.
4. Relieve any trapped pressure in the hydraulic system by using the handle or wrench (located in the toolbox) and move the double nut on the side of the actuator module on the valve section back and forth.
5. Label, disconnect and cap hydraulic hoses and cylinder ports in relation to the cylinder.
6. Attach a suitable sling to an appropriate lifting device to the cylinder. Make sure the device used can actually support the cylinder.
7. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
8. Remove the cylinder.
9. Wipe up any hydraulic fluid spillage in, on, near or around the machine.



8.9.2 General Cylinder Disassembly

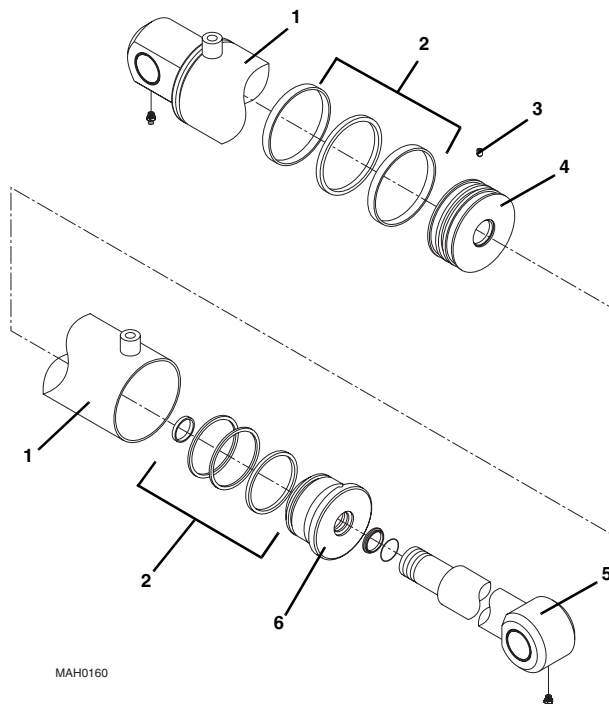
1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.



WARNING: Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder. Escaping hydraulic fluid under pressure can penetrate the skin, causing death or serious injury.

IMPORTANT: Avoid using excessive force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube.

3. If applicable, remove the counterbalance valve from the side of the cylinder barrel.



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IMPORTANT: DO NOT tamper with or attempt to adjust the counterbalance valve cartridge. If adjustment is necessary, replace the counterbalance valve with a new part.

4. Extend the rod (5) to allow access to the base of the cylinder.

IMPORTANT: Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.

5. Using a pin spanner wrench, unscrew the head gland (6) from the barrel (1). A considerable amount of force will be necessary to remove the head gland. Carefully slide the head gland down along the rod toward the rod eye end, away from the cylinder barrel.

IMPORTANT: When sliding the rod and piston assembly out of the tube, prevent the threaded end of the tube from damaging the piston. Keep the rod centered within the tube to help prevent binding.

6. Carefully pull the rod assembly along with the head gland out of the cylinder barrel.
7. Fasten the rod end in a soft-jawed vise, and put a padded support under and near the threaded end of the rod to help prevent damage to the rod.
8. Remove the set screw (3) from the piston (4).

Note: It may be necessary to apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 149-204° C (300-400° F) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

9. Remove the piston head (4) from the rod (5) and carefully slide the head gland (6) off the end of the rod.
10. Remove all seals, back-up rings and o-rings (2) from the piston head and all seals, back-up rings and o-rings from the head gland.

Note: The head gland bearing will need to be inspected to determine if replacement is necessary.

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts catalog for ordering information.



8.9.3 Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from complete seal kits to help ensure proper cylinder function.
2. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: If a white powdery residue is present on threads and parts, it can be removed. Clean the residue away with a soft brass wire brush prior to reassembly, and wipe with loctite cleaner before reinstallation.

8.9.4 Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the tube does not display a smooth finish, or is scored or damaged in any way, replace the tube.
2. Remove light scratches on the piston, rod or inner surface of the tube with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.

8.9.5 General Cylinder Assembly

1. Use the proper tools for specific installation tasks. Clean tools are required for assembly.
2. Install new seals, back-up rings and o-rings (2) on the piston (4) and the head gland (6).

Note: The extend/retract cylinder has a spacer that **MUST** be installed over the rod **AFTER** the head gland and **BEFORE** the piston head.

3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod (5) to prevent any damage to the rod.

IMPORTANT: Protect the finish on the rod at all times. Damage to the surface of the rod can cause seal failure.

4. Lubricate and slide the head gland (6) over the cylinder rod (5). Install the piston head (4) on to the end of the cylinder rod. Loctite and install the setscrew (3) in the piston head. Refer to Section 8.9.9, "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the piston head and the set screw.

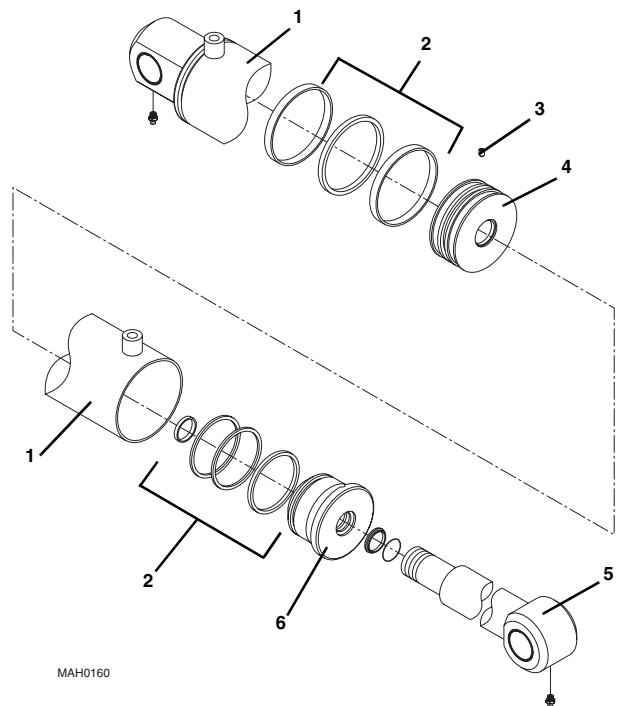
IMPORTANT: Avoid using excessive force when clamping the cylinder barrel in a vise. Apply only enough

force to hold the cylinder barrel securely. Excessive force can damage the cylinder barrel.

5. Place the cylinder barrel (1) in a soft-jawed vise or other acceptable holding equipment if possible.

IMPORTANT: When sliding the rod and piston assembly into the cylinder barrel, prevent the threaded end of the cylinder barrel from damaging the piston head. Keep the cylinder rod centered within the barrel to prevent binding.

6. Carefully insert the cylinder rod assembly into the tube.
7. Screw the head gland (6) into the cylinder barrel (1) and tighten with a spanner wrench. Refer to Section 8.9.9, "Hydraulic Cylinder Torque Specifications," for tightening guidelines for the head gland.
8. If applicable, thread the new counterbalance valve into the block on the cylinder barrel.





8.9.6 General Cylinder Installation

1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into its mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check fluid level of the hydraulic fluid reservoir and if necessary, fill to full mark with Mobilfluid 424® ISO Grade 46.
5. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing cylinder to fill with hydraulic oil.
6. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

8.9.7 Cylinder Pressure Checking

Attach a 345 bar (5000 psi) gauge to the test port on the main control valve to check the system pressure.

Note: *If a hydraulic cylinder pressure is greater than the main control valve pressure, increase the main control valve pressure by adjusting the main relief. Generally, one half turn clockwise will be adequate to check an individual circuit. Activate the circuit and if pressure is obtained, turn the main relief counter clockwise one half turn. Recheck the main relief setting and adjust if necessary.*

8.9.8 Steering Cylinders

The steering cylinders are attached to each axle center housing. The steer cylinders are covered in the appropriate Dana-Spicer axle literature.



Hydraulic System

8.9.9 Hydraulic Cylinder Torque Specifications

a. Lift Cylinder

Machine	Piston	Head	Set Screw
7 & 8M - Before S/N 1160000569	N/A	N/A	N/A
7 & 8M - S/N 1160000569 & After	2550-2600 Nm (1881-1917 lb-ft)	775-825 Nm (571-608 lb-ft)	20-25 Nm (15-19 lb-ft)
9M - Before S/N 1160000875			
9M- S/N 1160000875 & After	2490-2540 Nm (1837-1873 lb-ft)	950-1000 Nm (701-738 lb-ft)	20-25 Nm (15-19 lb-ft)
12M - Before S/N 1160000765			
12M - S/N 1160000765 & After	2490-2540 Nm (1837-1873 lb-ft)	950-1000 Nm (701-738 lb-ft)	20-25 Nm (15-19 lb-ft)
13M - Before S/N 1160000863			
13M - S/N 1160000863 & After	2490-2540 Nm	950-1000 Nm (701-738 lb-ft)	20-25 Nm (15-19 lb-ft)

b. Extend/Retract Cylinder

Machine	Piston	Head	Plug	Set Screw
7 & 8M - Before S/N 1160000569	N/A	N/A	N/A	N/A
7 & 8M - S/N 1160000569 & After	1290-1340 Nm (951-988 lb-ft)	400-450 Nm (295-332 lb-ft)	N/A	20-25 Nm (15-19 lb-ft)
9M - Before S/N 1160000875				
9M - S/N 1160000875 & After	1290-1340 Nm (951-988 lb-ft)	400-450 Nm (295-332 lb-ft)	N/A	20-25 Nm (15-19 lb-ft)
12M - Before S/N 1160000765				
12M - S/N 1160000765 & After	1070-1120 Nm (789-826 lb-ft)	480-530 Nm (354-391 lb-ft) (rear) 380-430 Nm (280-317 lb-ft) (front)	50-55 Nm (37-41 lb-ft)	20-25 Nm (15-19 lb-ft)
13M - Before S/N 1160000863				
13M - S/N 1160000863 & After	1070-1120 Nm (789-826 lb-ft)	480-530 Nm (354-391 lb-ft) (rear) 380-430 Nm (280-317 lb-ft) (front)	50-55 Nm (37-41 lb-ft)	20-25 Nm (15-19 lb-ft)

**c. Tilt Cylinder**

Machine	Piston	Head	Nut	Set Screw
7 & 8M - Before S/N 1160000569 9M - Before S/N 1160000875 12M - Before S/N 1160000765 13M - Before S/N 1160000863	800 Nm (590 lb-ft)	1200 Nm (885 lb-ft)	130 Nm (96 lb-ft)	N/A
7 & 8M - S/N 1160000569 & After 9M - S/N 1160000875 & After 12M - S/N 1160000765 & After 13M - S/N 1160000863 & After	2850-2900 Nm (2102-2139 lb-ft)	775-825 Nm (572-608 lb-ft)	N/A	20-25 Nm (15-19 lb-ft)

d. Compensation Cylinder

Machine	Piston	Head	Nut	Set Screw
7 & 8M - Before S/N 1160000569 9M - Before S/N 1160000875 12M - Before S/N 1160000765 13M - Before S/N 1160000863	N/A	N/A	800 Nm (590 lb-ft)	N/A
7 & 8M - S/N 1160000569 & After 9M - S/N 1160000875 & After 12M - S/N 1160000765 & After 13M - S/N 1160000863 & After	850-900 Nm (627-664 lb-ft)	380-430 Nm (280-317 lb-ft)	N/A	20-25 Nm (15-19 lb-ft)

e. Sway Cylinder

Machine	Piston	Head	Plug	Nut	Set Screw
7 & 8M - Before S/N 1160000569 9M - Before S/N 1160000875 12M - Before S/N 1160000765 13M - Before S/N 1160000863	600 Nm (443 lb-ft)	800 Nm (590 lb-ft)	150 Nm (111 lb-ft)	100 Nm (74 lb-ft)	N/A
7 & 8M - S/N 1160000569 & After 9M - S/N 1160000875 & After 12M - S/N 1160000765 & After 13M - S/N 1160000863 & After	1050-1100 Nm (774-811 lb-ft)	400-450 Nm (295-332 lb-ft)	N/A	N/A	20-25 Nm (15-19 lb-ft)

f. Outrigger Cylinder

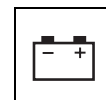
Machine	Piston	Head	Plug	Nut
12M - Before S/N 1160000765 13M - Before S/N 1160000863	700 Nm (516 lb-ft)	1000 Nm (737 lb-ft)	150 Nm (111 lb-ft)	100 Nm (74 lb-ft)
12M - S/N 1160000765 & After 13M - S/N 1160000863 & After	1300-1350 Nm (959-995 lb-ft)	625-675 Nm (461-498 lb-ft)	N/A	N/A



Hydraulic System

g. Attachment Lock

Machine	Piston	Nut	Set Screw
7 & 8M - Before S/N 1160000569 9M - Before S/N 1160000875 12M - Before S/N 1160000765 13M - Before S/N 1160000863	N/A	N/A	45 Nm (33 lb-ft)
7 & 8M - S/N 1160000569 & After 9M - S/N 1160000875 & After 12M - S/N 1160000765 & After 13M - S/N 1160000863 & After	70-80 Nm (52-59 lb-ft)	75-85 Nm (55-63 lb-ft)	N/A



Section 9

Electrical System

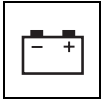
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Electrical System

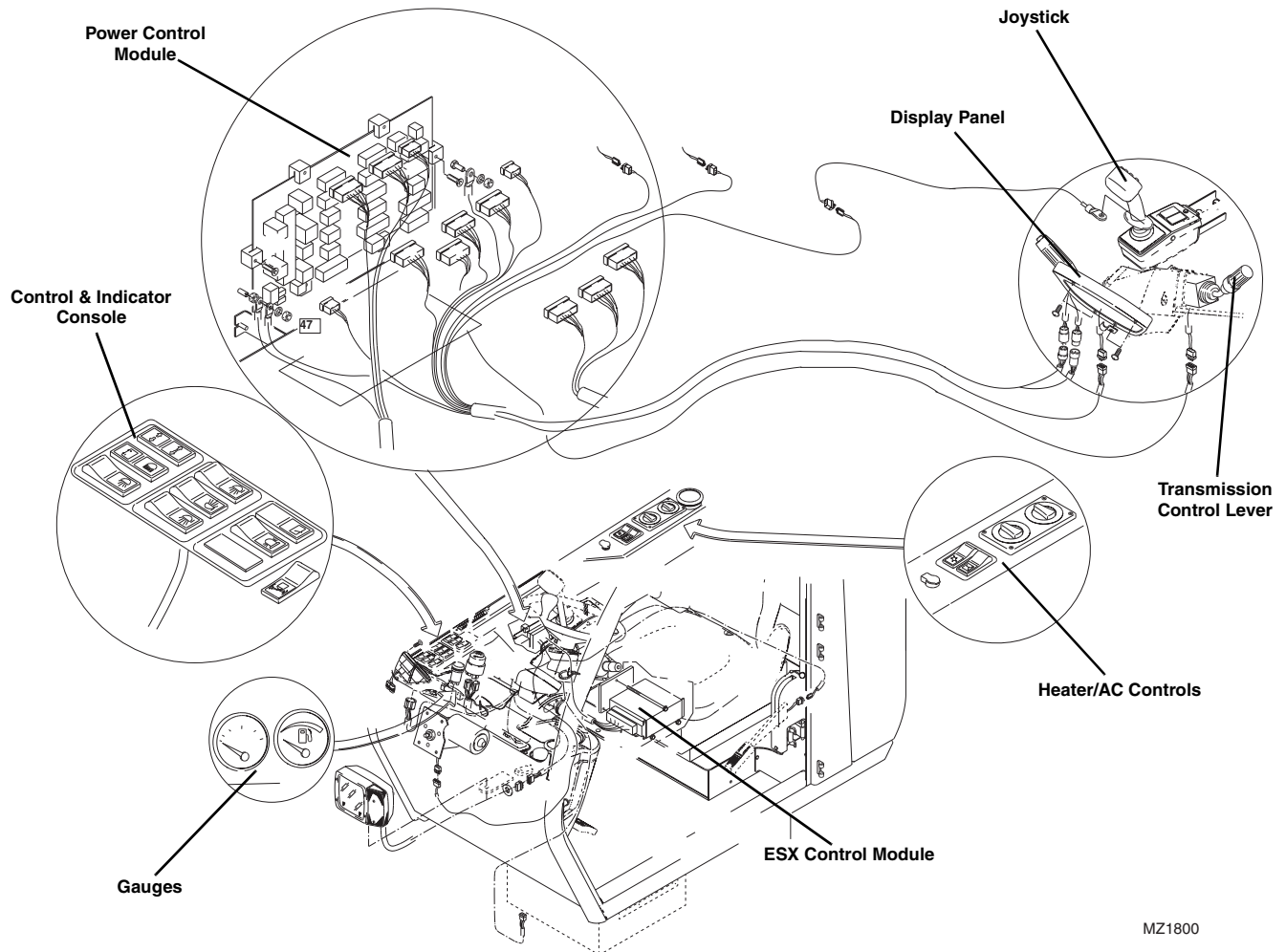
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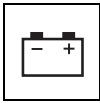
9.1 ELECTRICAL COMPONENT TERMINOLOGY

To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the machine. The following illustration identifies the components that are referred to throughout this section.

9.1.1 General Overview (Cab Harness)



MZ1800



Electrical System

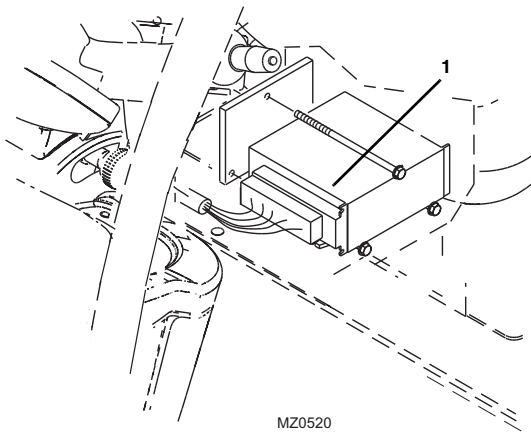
9.2 SPECIFICATIONS

Electrical system specifications are listed in Section 2, "General Information and Specifications."

9.3 SERVICE WARNING



CAUTION: When doing welding anywhere on the machine, disconnect the wire harness from the ESX Control Module (1) mounted under the operator's seat and disconnect all cables from the battery.

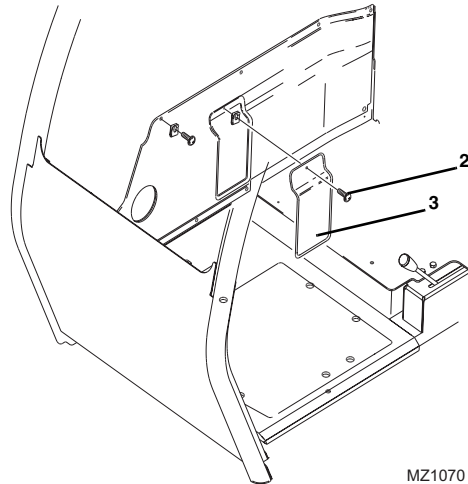


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9.4 FUSES AND RELAYS

9.4.1 Cab

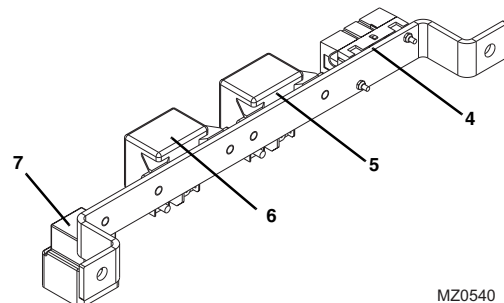
For access to the fuse and relay panel, remove the screw (2) securing the right side console access panel (3) to the cab. The fuses and sealed 12-volt relays are mounted under the right side console access panel. The fuse and relay panels are part of the cab harness.



MZ1070

9.4.2 Engine Compartment

The fuse and relay bar is located on the frame directly above the engine. The fuse and relay bar contains the lift pump and glow plug fuses (4), starter relay (5), glow plug relay (6) and lift pump relay (7). To remove the relays from inside the engine compartment, remove the mounting screws and washers. When re-installing the relays, torque the mounting hardware to 7-12,5 Nm (62-110 lb-in).

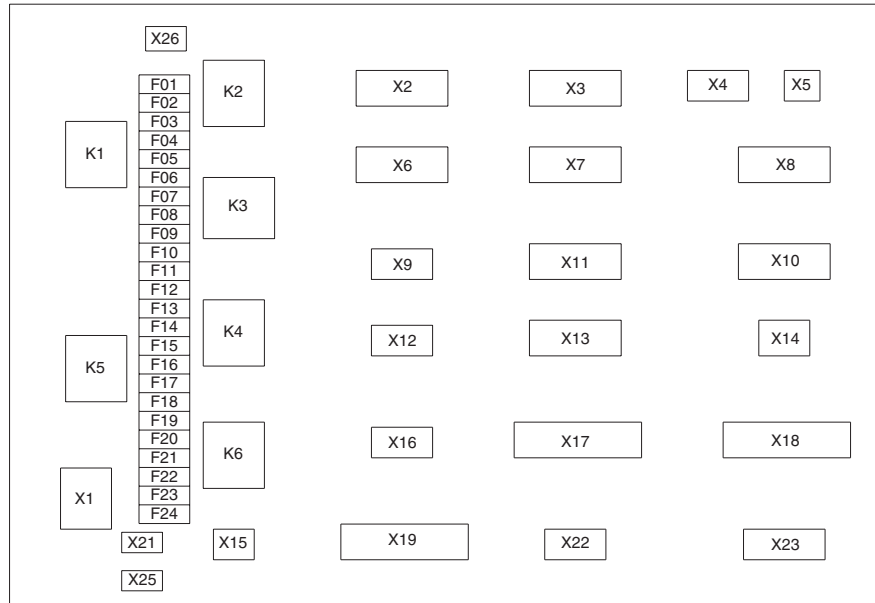


MZ0540

Note: On machines before S/N 1160000358, the fuse and relay bar is not present. Only the starter relay is mounted on the frame above the engine.

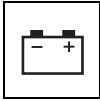


9.4.3 Power Control Board



MZ1560

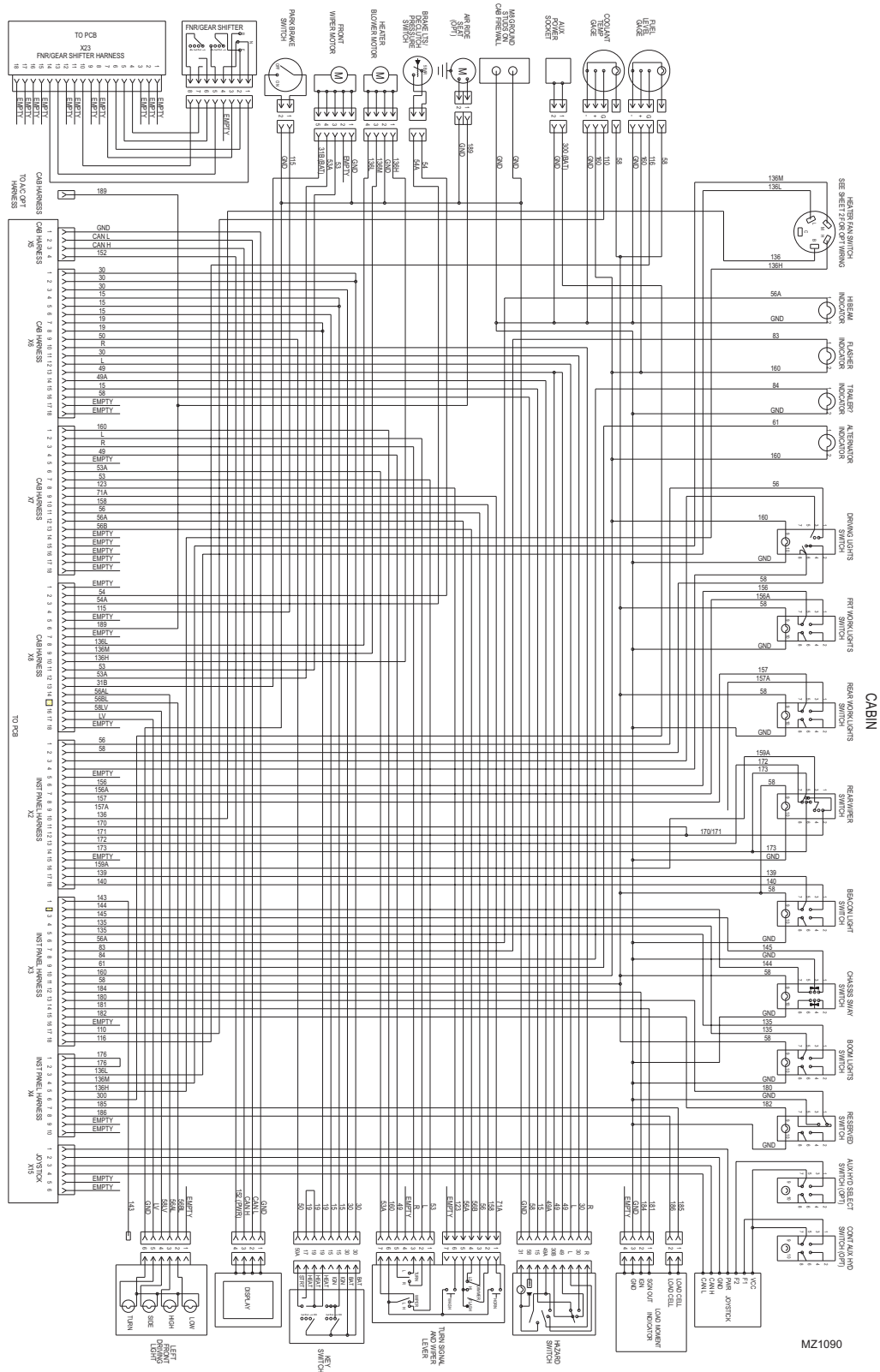
Fuse/Relay	Function	Amp Rating
F1	Rear Work Lights	15
F2	Cab Heater	15
F3	Left Headlight Low	7.5
F4	Right Headlight Low	7.5
F5	Left Headlight High	7.5
F6	Right Headlight High	7.5
F7	Left Tail and Side Lights	7.5
F8	Right Tail and Side Lights, Display	7.5
F9	Aux Pwr Socket	15
F10	Battery Ind Light, Dome Light	15
F11	ESX Battery	25
F12	Key Switch	30
F13	Spare	15
F14	Brake Lights, Cold Start, Beacon	10
F15	Ignition	15
F16	Rear Wiper	20
F17	Front Wiper	20
F18	Front Work Lights	15
F19	Boom Work Lights	15

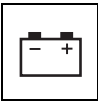


Electrical System

F20	PVG Clip	10
F21	Air Conditioning	25
F22	Radio	5
F23	Transmission	10
F24	ESX Ignition and Sensors	7.5
X1	PCB Pwr & Gnd Harness	
X2	Instrument Panel Harness	
X3	Instrument Panel Harness	
X4	Instrument Panel Harness	
X5	Cab Harness	
X6	Cab Harness	
X7	Cab Harness	
X8	Cab Harness	
X9	Worklight, Radio, Rear Wiper Harness	
X10	Front Chassis Harness	
X11	Engine Harness	
X12	Rear Chassis Harness	
X13	Rear Chassis Harness	
X14	Optional Trailer(ing) Harness	
X15	Joystick Connector	
X16	Front Chassis Harness	
X17	ESX Harness	
X18	ESX Harness	
X19	ESX Harness	
X21	CAN Diagnostic Connector	
X22	Front Chassis Harness	
X23	F-N-R and Gear Shifter Harness	
X25	RS232 Diagnostic Connector	
X26	Tilt Sensor-not used	
K1	Key (Power) Relay	
K2	Start Interlock Relay	
K3	Flasher	
K4	Wiper Relay	
K5	Work Lights Relay	
K6	Fuel Solenoid Relay	

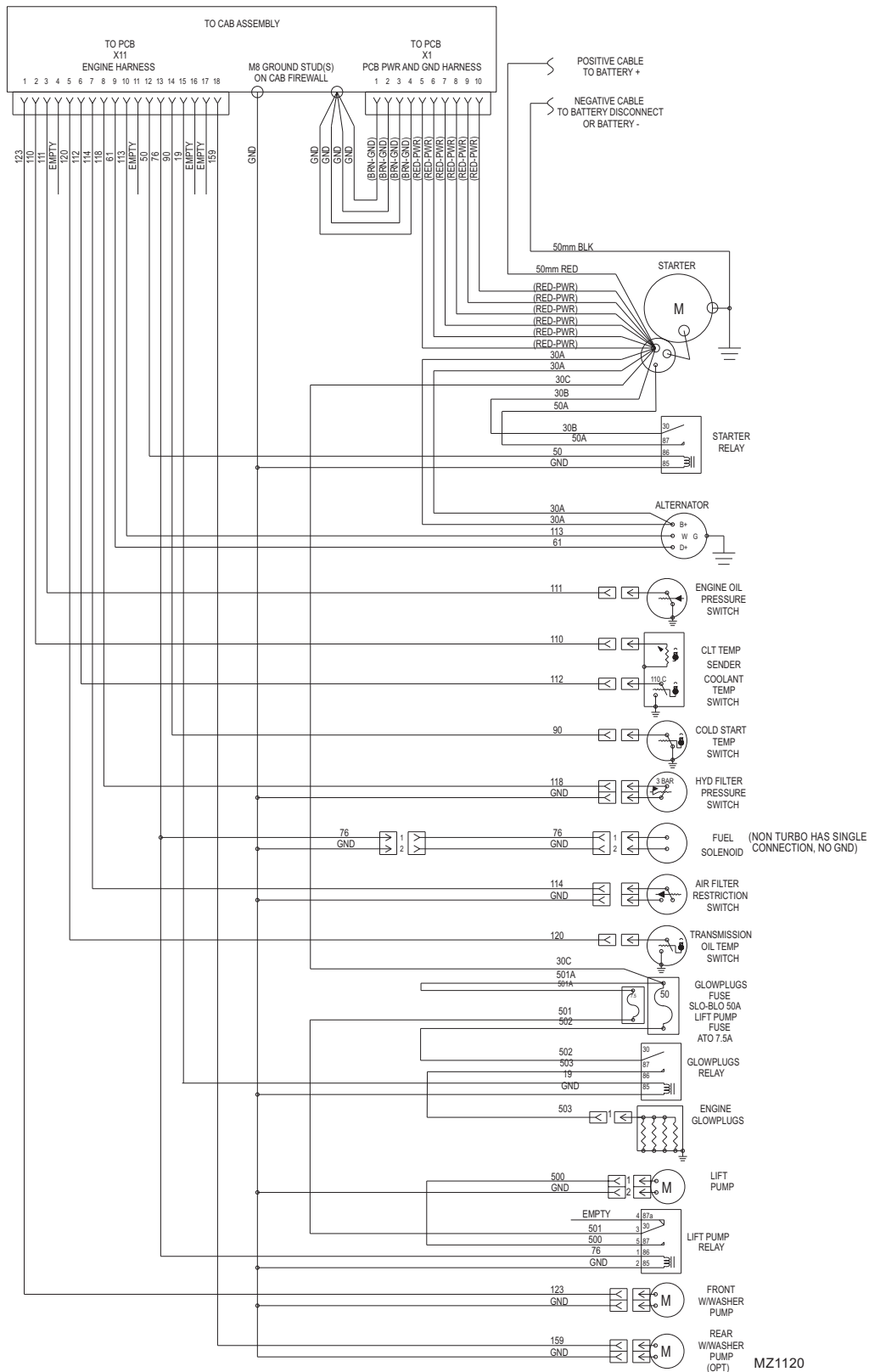
9.5.1 Cab Harness Electrical Schematic





Electrical System

9.5.2 Engine Harness Electrical Schematic



3507, 3508, 3509, 3512, 3513, 4007, 4008, 4009, 4012, 4013





9.10 3507, 3508, 3509, 3512, 3513, 4007, 4008, 4009, 4012, 4013



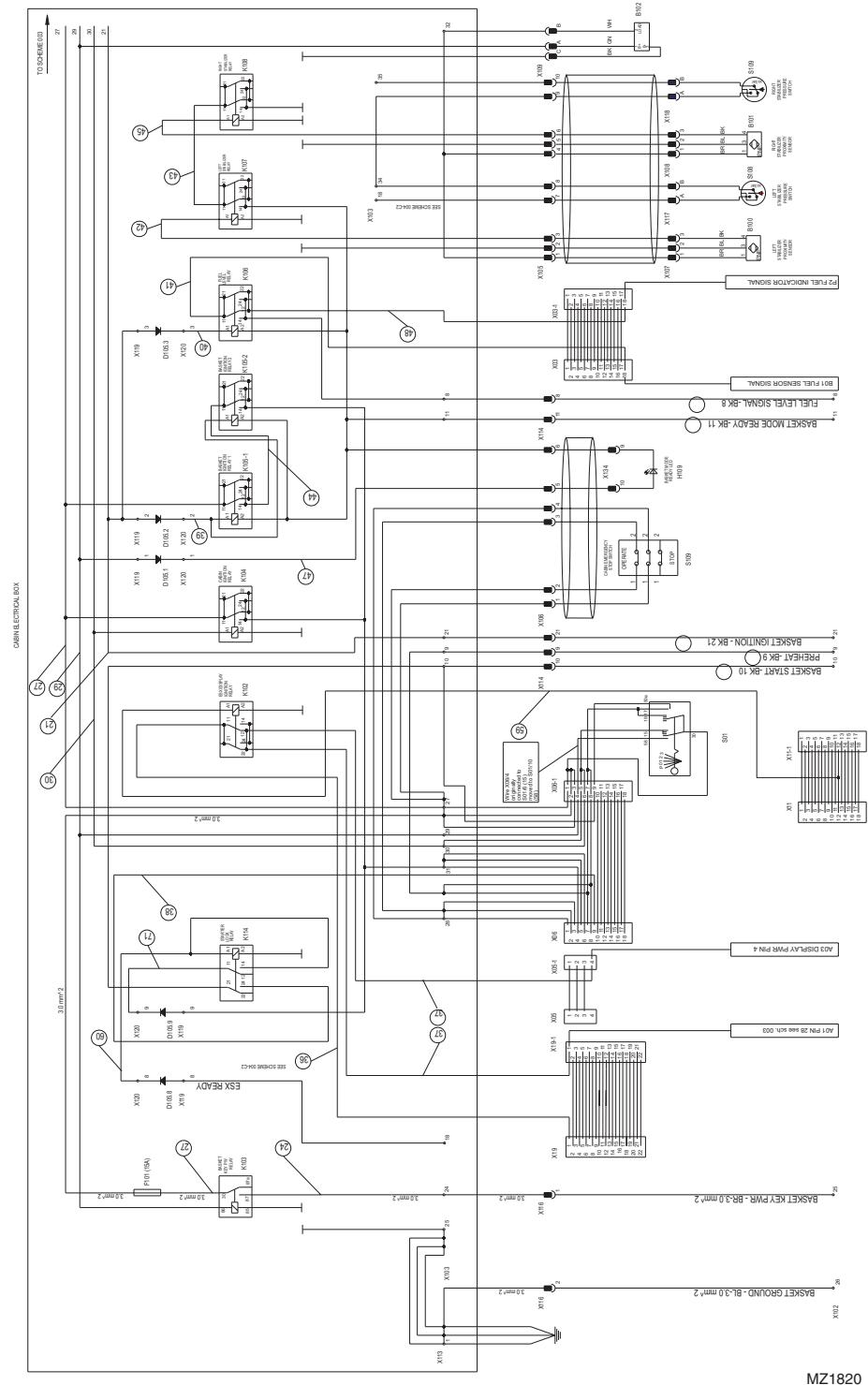


9.12

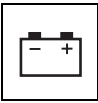




9.5.7 Cab Harness - Platform Machines Only

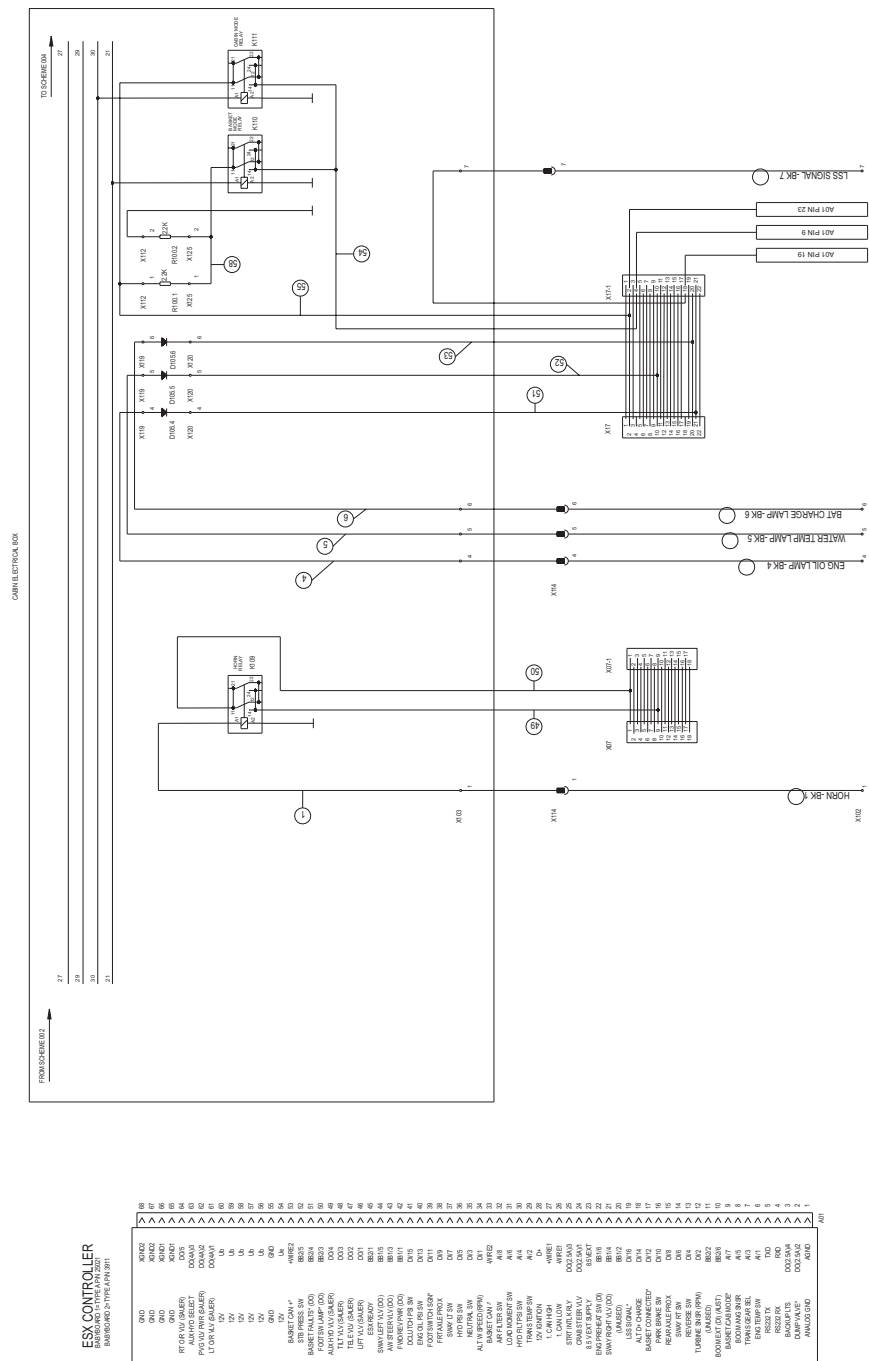


MZ1820



Electrical System

9.5.7 Cab Harness - Platform Machines Only (Continued)



MZ1830

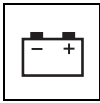
3507, 3508, 3509, 3512, 3513, 4007, 4008, 4009, 4012, 4013





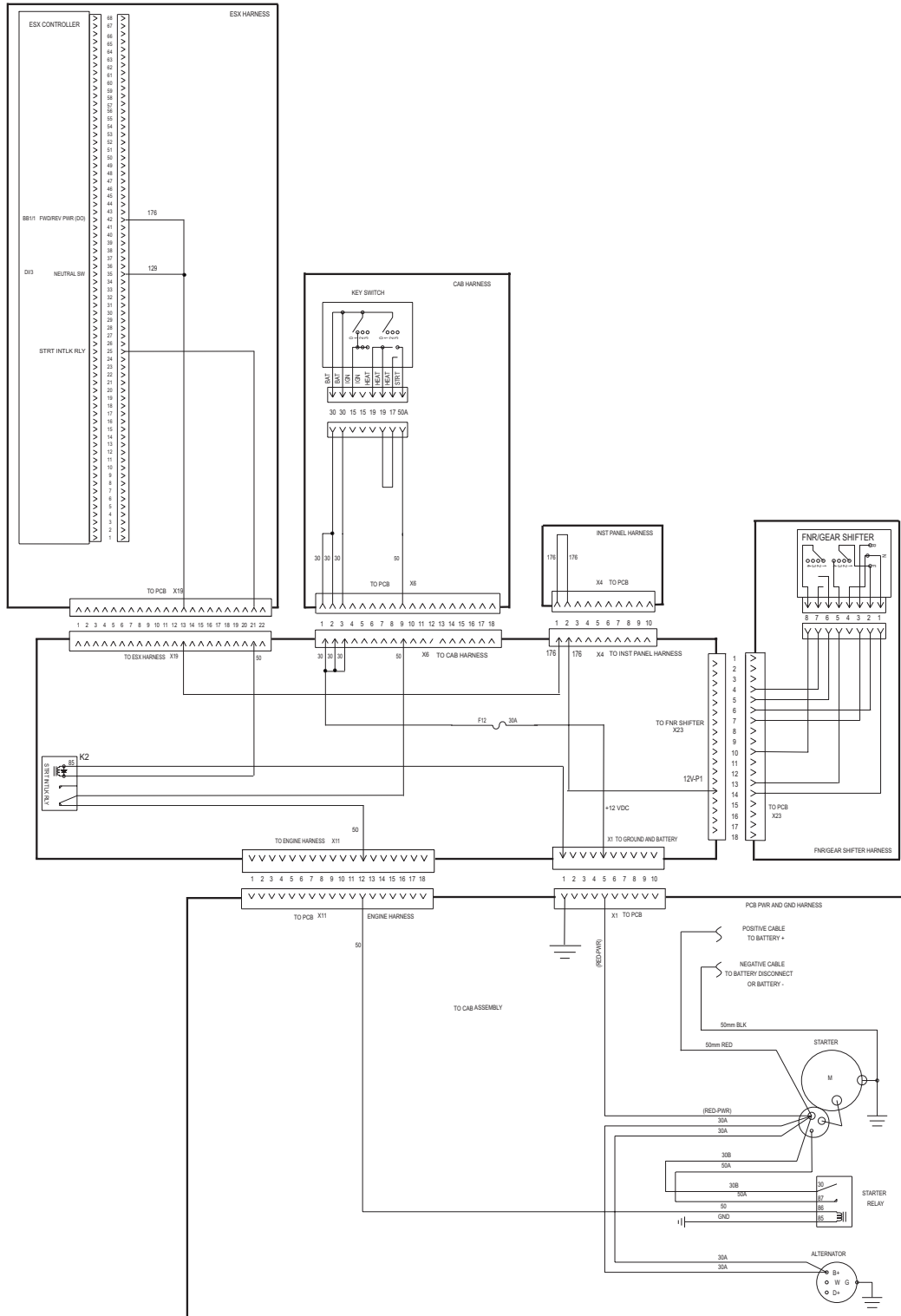
9.16





Electrical System

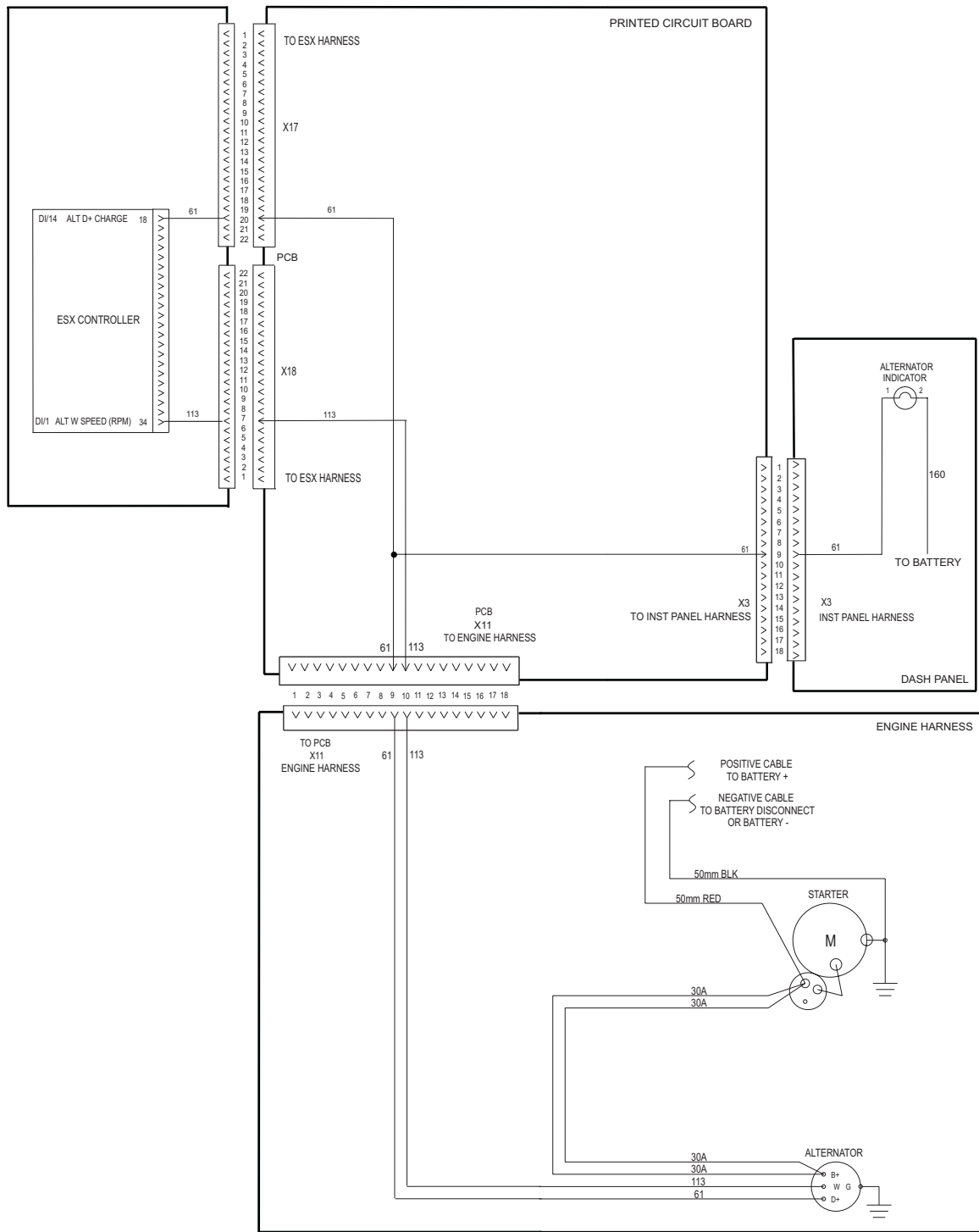
9.6.2 Start Circuit



MZ1290



9.6.3 Charging Circuit



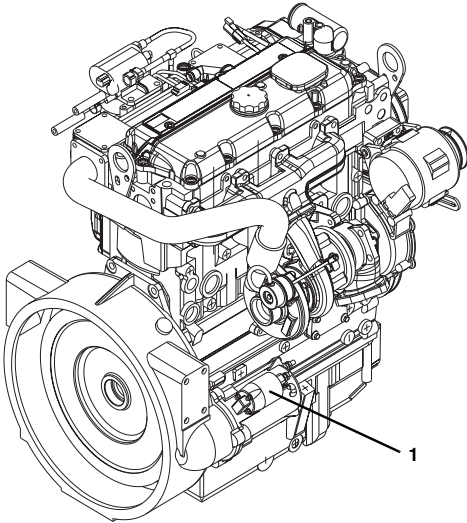
MZ1280



9.7 ENGINE START CIRCUIT

9.7.1 Starter

The starter (1) is located on the left side of the engine (the right side of the machine).



MZ0150

a. Testing the Starter on the Engine

If the starter does not engage when the ignition key switch is turned, check the following:

1. The main fuse may be blown, requiring replacement. Check for the cause of the blown fuse.
2. There may be a defect in the ignition key switch, ignition wiring or starter solenoid.
3. Check battery condition. Clean the battery posts and the connectors at each end of the battery cables.
4. Check for broken wiring and damaged insulation on the wiring. Replace all broken or damaged wiring.
5. Check all connections at the starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
6. If the starter still does not operate after these checks have been performed, check the starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a “whirring” noise is heard but the engine does not turn over, the starter is spinning but not engaging the flywheel. The starter drive or solenoid that pushes the drive forward to engage the flywheel may be

defective. Missing or damaged teeth on the flywheel can also prevent the starter from cranking the engine.

3. If the starter only “clicks” it may indicate that the battery is discharged, or that there is a loose or corroded battery cable connection. Check the battery state of charge and battery condition first, then check the cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.6.2, “Start Circuit.”

c. Starter Removal

Remove the starter only if it fails. To remove the starter:

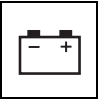
1. Open the engine cover. Allow the engine to cool.
2. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
3. Remove the wires from the solenoid stud. Remove the positive (+) battery cable from the starter. Label and disconnect the wire from the starter solenoid housing stud. Record how the wires are installed to ensure correct installation later.
4. Loosen, but **DO NOT** remove the three fasteners securing the starter to the flywheel housing. Support the starter securely, as it is relatively heavy and will fall if not supported.
5. Support the starter and remove the fasteners securing the starter to the engine. Remove the negative (-) ground cable from its starter mounting bolt.
6. Remove the starter from the machine.

d. Starter Cleaning and Drying

1. While the starter is being removed, wipe away any grease or dirt that has accumulated around the starter mounting opening.
2. If reinstalling the starter, clean the exterior of the starter with an approved solvent. **DO NOT** submerge the starter or allow the solvent to contact the starter bushings.
3. Dry the starter with a clean, lint-free cloth.

e. Starter Periodic Maintenance

A starter requires no routine maintenance beyond the occasional inspection of the electrical connections, which must be clean and tight. The starter is not serviceable; replace a defective starter with a new unit.



f. Starter Installation

1. Position the starter in its mounting opening on the flywheel housing. Position the ground cable over the correct starter mounting bolt. Secure the starter with fasteners. Torque fasteners to 43 Nm (32 lb-ft).
2. Connect the positive (+) battery cable to the upper solenoid stud. Install the wires to the upper solenoid stud, and secure with lockwasher and nut. Torque nuts to 43 Nm (32 lb-ft).
3. Connect the wire to the solenoid mounting stud.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

9.8 CHARGING CIRCUIT

Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine. (Refer to the appropriate Operation & Safety Manual.) Allow the engine to run, which will enable the alternator to charge the battery.

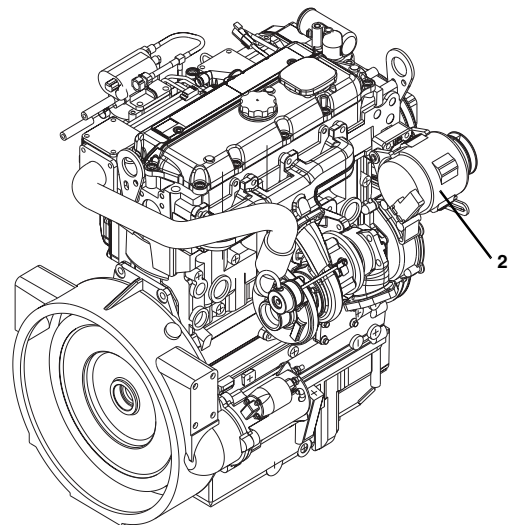
If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check the all battery cable connections at the battery, and verify that they are clean and tight.
2. Check the external alternator wiring and connections, and verify that they are in good condition.
3. Check the fan belt condition and tension.
4. Verify that the alternator mounting hardware is tight.
5. Run the engine and check the alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.

9.8.1 Alternator

a. Alternator Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Loosen both alternator (2) mounting bolts and pivot alternator in.
6. With the fan belt now being loose, remove the belt from the engine.



MZ0150

Note: Record how the alternator is installed to ensure correct installation later.

7. Label and disconnect the wire leads attached to the alternator.
8. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
9. While supporting the alternator with one hand, remove the upper (longer) mounting hardware from the upper alternator mount. Remove the alternator from the machine.



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b. Alternator Installation

1. Position the alternator and align with the upper alternator mount on the engine bracket. Insert the upper mounting hardware through the alternator mount. **DO NOT** tighten completely at this time.
2. Align the lower alternator mount hole with the lower mounting bracket on the engine. Insert the lower mounting capscrew. **DO NOT** tighten completely at this time.
3. Install the fan belt, adjust the alternator for proper belt tension and belt alignment. Tighten the lower capscrew and upper capscrew securely.
4. Connect the previously labeled wire leads.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Close and secure the engine cover.

9.9 ELECTRICAL SYSTEM COMPONENTS

9.9.1 Load Moment Indicator

The Load Moment Indicator provides a visual indication for forward stability limitations.

- All five LED's will light (three green, yellow & red) and the warning buzzer sounds as the machine reaches its forward stability limitations.
- The red LED is illuminated when the machine has reached its forward stability limitations.
- Overload Protection Function. When the red LED is illuminated the automatic overload protection function is activated. Boom extension and lower functions are disabled.

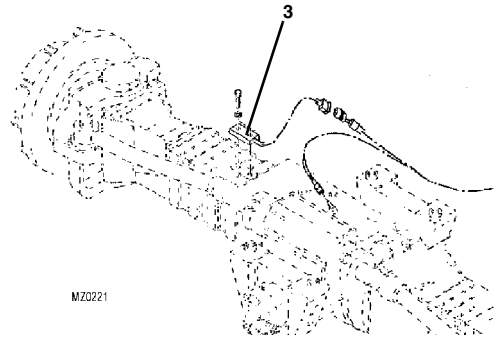
Test the LMI at the beginning of each work shift.

1. **Fully retract and level the boom, with no load. Do not raise the boom during this test.**
2. Level frame using level in cab.
3. Press the test button on the LMI display. This will cause all LEDs to flash on and an audible warning to sound. This indicates that the system is functioning properly. If the test gives a different result, the system is not functioning properly and the machine must be removed from service and repaired before continued operation.

Note: The Load Moment Indicator is **NOT** a serviceable item. The Load Moment Indicator must be inspected and/or replaced by a qualified dealer or a JLG technician.

9.9.2 Load Moment Sensor

The LMI sensor (3) is bolted on the top right of the rear axle.



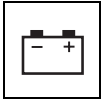
a. Load Moment Sensor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Disconnect the LMI electrical connector.
6. Loosen and remove the two bolts holding the LMI assembly to the rear axle.
7. Remove the sensor assembly.

b. Load Moment Sensor Installation

1. Clean the bare metal with a degreasing solution and allow to dry.
2. Apply a thin film of Loctite® 638 adhesive to the flat metal surface of the transducer, ensuring the adhesive is spread evenly over the entire surface.
3. Fit the transducer, ensuring the lead exits in the corner direction. If the existing bolts are not available, use M10 x 40mm bolts with a minimum tensile strength of 10.9. No washers are used.

Note: It is important to prevent distortion of the sensor element, therefore tighten the bolts alternately a small amount at a time, until a value of 70 Nm (50 lb-ft) is achieved.



4. Leave the machine undisturbed for a minimum of 2 hours before moving. DO NOT lift any load for a minimum of 12 hours.
5. The transducer and area around it can be painted 2 hours after installation.
6. Plug the electrical connector into the sensor assembly.
7. Connect the battery negative (-) cable to the battery negative (-) terminal.
8. Close and secure the engine cover.

c. Load Moment Sensor Calibration

Calibration of the load moment sensor requires the setting up of two reference points. 0% and 100% SWL. During calibration the machine must be level, brakes off, steering straight ahead and ignition turned on. Access to the calibration mode requires the use of the magnetic "key".

Acquiring the calibration mode

For the first calibration at installation:

When first installed and powered up, the display will show error condition number 4 (red LED and 3rd green LED), indicating that calibration is required. PRESS and hold the TEST button, and place the magnet in position level with and just to the right of the TEST button. The correct position is indicated when the sounder stops and all LEDs stay on. KEEP HOLDING THE TEST BUTTON AND MAGNET IN PLACE until the display changes again to show the red LED only. This indicates that the system is now in calibrating mode, and waiting for the first reference point.

RELEASE the TEST button and remove the magnet. The display will emit short intermittent beeps to remind the operator that calibration is in progress.

Note: If either the button or magnet is released too early the display will revert to the uncalibrated condition number 4.

THE SYSTEM ALLOWS FIVE MINUTES for each part of the calibration procedure to be completed. If a part of the calibration procedure is not completed within the five minutes allowed, the system will automatically revert to the uncalibrated error condition number 4.

IF THE IGNITION IS SWITCH OFF during first calibration the system will remain in the uncalibrated condition.

For any subsequent calibration:

PRESS and hold the TEST button, and place the magnet in position level with and just to the right of the TEST button. The display will show all LEDs flashing and sounder on. The correct position is indicated when the sounder stops and all LEDs stay on.

Calibration Procedure:

1. Set 0%
ARRANGE the machine on level ground in the 0% calibration position (boom is retracted, forks lowered but not resting on the ground, and no load on the forks).
PRESS the TEST button ONCE. The system will give a single, short beep indicating that the 0% point is set. The display will change to show the red and amber LEDs lit (with continuing intermittent beeps), indicating that the system is ready and waiting for the 100% reference.

Note: If a long beep is emitted from the sounder during calibration, this indicates a fault condition - see below.

2. Set 100%
PICK up the calibrated (maximum capacity) 100% load and extend the boom to the pre-determined, normal 100% point.
PRESS the TEST button ONCE to set the 100% reference. The display will now change back to normal operation, and show 100% (all green and amber LEDs lit and flashing).
System calibration has now been completed. No further action is required.

9.9.3 Back-up Alarm

The back-up alarm is located at the rear of the machine. When the transmission shift control switch (transmission control lever) is shifted to the (R) REVERSE position, the back-up alarm will automatically sound.

Place the transmission control lever in (R) REVERSE to test the back-up alarm. The back-up alarm must not sound when the transmission control lever is in (N) NEUTRAL or (F) FORWARD. Also, with the ignition key switch in the RUN position, the back-up alarm will sound when the transmission control lever is shifted into the (R) REVERSE position.

a. Disassembly

DO NOT disassemble the back-up alarm. Replace a defective or faulty alarm with a new part.



Electrical System

b. Inspection and Replacement

Inspect the wiring harness connector and alarm terminals for continuity and shorting. Test the alarm by turning the ignition key switch to the RUN position and shifting the transmission control lever into the REVERSE position. The alarm should sound.

Replace a defective or faulty alarm with a new part.

9.10 WINDOW WIPER/WASHER

9.10.1 Windshield Wiper Motor

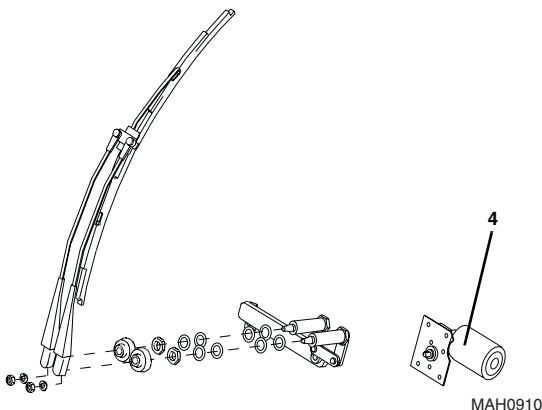
a. Removal

Note: It may be necessary to remove several hydraulic hoses from under the dash in order to remove and install the wiper motor housing.

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the lower dash panel.
6. Disconnect the right side defroster hose from dash panel hose connector.

IMPORTANT: DO NOT start the engine with the hoses not connected to their proper fittings.

7. Disconnect the cab harness connectors from the wiper motor.



8. Remove the linkage attached to the wiper motor (4).

9. Loosen and remove the four bolts holding the wiper motor to the mounting bracket.

Note: Retain all hardware removed from the wiper assembly for possible reuse on the replacement motor housing.

10. Remove the motor from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

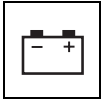
Inspect the motor terminals for continuity. Replace motor if continuity is not found.

d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the mounting bracket.
3. Connect the wiper linkage to the wiper motor shaft.

Note: Align the wiper linkage arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.

4. Connect the cab harness connectors to windshield wiper motor connectors.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
7. Install right side defroster hose to the dash panel hose connector.
8. If previously removed, install hydraulic hoses under the dash.
9. Install the lower dash panel.
10. Close and secure the engine cover.



9.10.2 Rear Window Wiper Motor

a. Removal

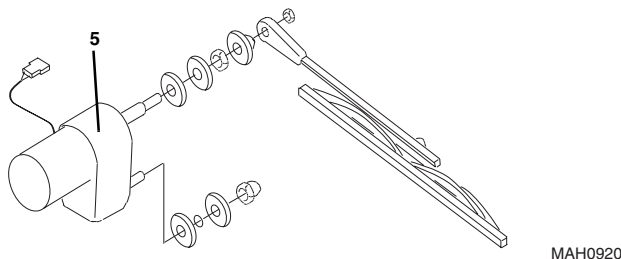
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the wiper arm from the wiper motor (5) shaft.
6. Remove the nut on the wiper motor shaft and on the wiper motor.
7. From inside the cab, pull the wiper motor away from the rear window.
8. Pull the cab headliner down in the rear right corner. Label and disconnect the cab harness connectors from the wiper motor.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Installation and Testing

1. Hold wiper motor up toward cab rear window and install the cab harness connectors. Refit the headliner.
2. With the help of an assistant, insert the wiper motor through the roof hole and have the assistant thread the hex nuts onto the wiper motor shaft and the wiper motor. Insure that the motor housing is facing the front of the cab.



3. Install the wiper arm onto the wiper motor shaft.
4. Connect the battery negative (-) cable to the battery negative (-) terminal.

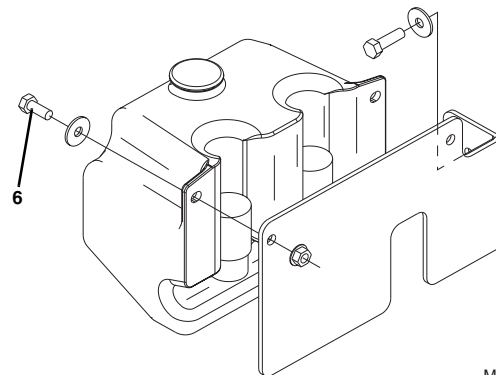
5. Turn ignition key switch to the RUN position and turn the rear wiper switch to the ON position. Ensure wiper stays on the window through a full stroke. Turn the rear wiper switch to the OFF position.
6. Engage the washer switch and ensure washer fluid is sprayed on the rear window. Turn the ignition key switch to the OFF position.
7. Close and secure the engine cover.

9.10.3 Windshield Washer Reservoir and Pump

The windshield washer motor and reservoir is located in the engine compartment as a unit and cannot be serviced separately.

a. Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the nuts and the lockwashers from the washer mounting studs (6).
6. Pull the washer reservoir out and away from the mounting studs.



7. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
8. Remove the windshield washer hoses from the reservoir.



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b. Disassembly

DO NOT disassemble the pumps. The pump is not serviceable. Replace pumps if found to be defective.

c. Cleaning and Drying

Without submerging the pumps, clean the pumps and reservoir with an approved solvent and dry with a clean, lint-free cloth.

d. Inspection and Replacement

Inspect the electrical terminals for continuity.

e. Installation and Testing

1. Connect the windshield washer hoses to the reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install the reservoir tank onto the mounting studs.
4. Install the lockwashers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Connect the battery negative (-) cable to the battery negative (-) terminal.
7. Turn the ignition key switch to the RUN position and press the washer switches. Verify that fluid is sprayed on both the windshield and rear glass.
8. Close and secure the engine cover.

9.11 CAB HEATER AND FAN

9.11.1 Cab Heater Controls

Note: If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced. For additional information on the removal and installation of the heater box, refer to Section 4.3.8, "Heater/Defroster System."

a. Cab Heater Controls Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.

4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the four screws from the cab heater and fan control panel.
6. Pull the control panel out from the dash panel and disconnect the variable speed fan control cab harness connector and disconnect the temperature cable.
7. Remove the control from the panel.

b. Disassembly

DO NOT disassemble the cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

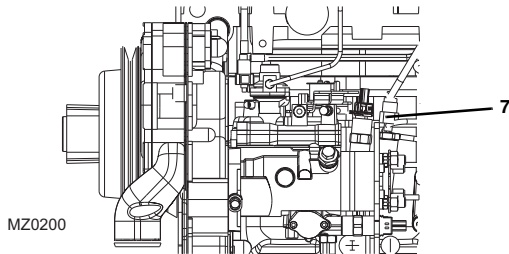
c. Installation and Testing

1. Check that the variable speed fan control is in the OFF position.
2. Install the temperature control cable to the back of the control.
3. Install the hex locknut on the shaft and tighten.
4. Connect the cab harness connector to the variable speed fan control.
5. Install the screws securing the control panel to the dash panel.
6. Connect the battery negative (-) cable to the battery negative (-) terminal.
7. Turn the ignition key to the ON position and check the fan speeds. If further repair is needed, refer to Section 9.5, "Electrical System Schematics."
8. Start the machine and allow engine to reach operating temperature. Check heat control at different levels.
9. Close and secure the engine cover.



9.12 SWITCHES, SOLENOIDS AND SENDERS

9.12.1 Fuel Shut-off Solenoid



a. Fuel Shut-off Solenoid Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Disconnect the wiring connector at the fuel shut-off solenoid lead.
6. Remove the fuel shut-off solenoid (7) from the fuel injector pump.

b. Fuel Shut-off Solenoid Disassembly

DO NOT disassemble a fuel shut-off solenoid. Replace a defective fuel shut-off solenoid with a new part.

c. Fuel Shut-off Solenoid Inspection and Replacement

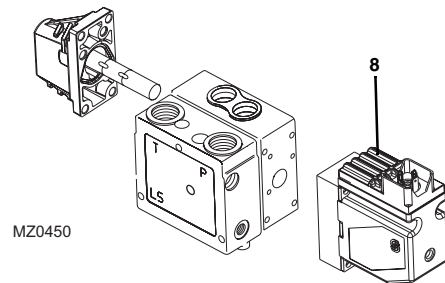
Use a 12-volt DC source and ground to test the solenoid. Energize the solenoid and watch for the plunger to retract. If the plunger does not retract, replace the fuel shut-off solenoid with a new solenoid.

d. Fuel Shut-off Solenoid Installation

1. Clean the exterior of the fuel injector pump.
2. Install the fuel shut-off solenoid on the fuel injection pump. **Do not over tighten.**
3. Connect the wiring connector at the fuel shut-off solenoid lead.

4. Connect the battery negative (-) cable at the battery negative (-) terminal.
5. Start the engine. If the engine starts, the fuel shut-off solenoid is functioning. If the engine fails to start, the fuel shut-off solenoid may have a poor ground connection. Visually check the wiring at the fuel shut-off solenoid leads and/or check for continuity with a voltmeter as required.
6. Check for fuel and/or oil leakage around the solenoid.
7. Close and secure the engine cover.

9.12.2 Main Control Valve Solenoids



a. Main Control Valve Solenoid Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
 2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
 3. Open the engine cover. Allow the engine to cool.
 4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
 5. Disconnect the wiring connector at the valve solenoid lead.
 6. Loosen and remove the four allenhead mounting screws.
 7. Remove the valve solenoid (8) being careful not to lose or damage any o-rings. Note the location of any orifices, check valves and o-rings if equipped.
- b. DO NOT** disassemble a valve solenoid. Replace a defective valve solenoid with a new solenoid.

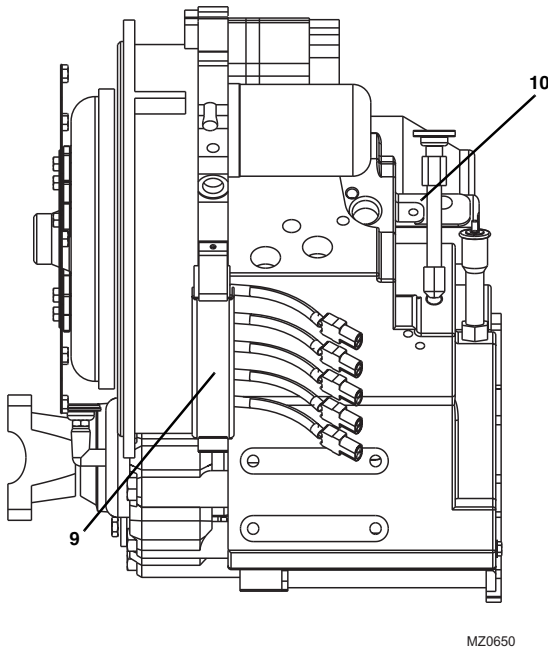


Electrical System

c. Main Control Valve Solenoid Installation

1. Install the valve solenoid using new o-rings and tighten the allenhead screws. **Do not over tighten.**
2. Connect the wire connector to the valve solenoid.
3. Connect the battery negative (-) cable to the battery negative (-) terminal.
4. Start the machine and slowly move joystick to engage function. If further troubleshooting is required, refer to Section 9.5, "Electrical System Schematics," or Section 8.5, "Hydraulic Schematics."
5. Close and secure the engine cover.

9.12.3 Transmission Solenoid Valves



If the transmission is not shifting properly, the transmission control lever, wiring harness or transmission shift solenoids (9) should be checked in order to determine which component is defective. Specific information to determine which travel position and corresponding component is not responding can be found in the detailed transmission service instructions are provided in the Dana-Spicer T12000 Transmission Repair Manual, P/N 31200163 and can be obtained by calling your local JLG distributor.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Note: Contact the JLG Service Department if internal transmission repair is required during the warranty period.

9.12.4 Transmission Temperature Sender

The transmission temperature sender is located at the bottom right side of the transmission housing.

a. Transmission Temperature Sender Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Unplug the transmission temperature sender connector from the wiring harness connector.
6. The sender is threaded into the transmission housing. Remove the sender.

b. Transmission Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Transmission Temperature Sender Installation and Testing

1. Thread the transmission temperature sender into the transmission housing snugly, then connect the sender connector to the wiring harness connector.
2. Connect the battery negative (-) cable to the battery negative (-) terminal.
3. Check for proper fluid level.
4. Start the engine, allow it to reach operating temperature and observe the operator's display cluster for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a shorted wire, damaged transmission, improper or low fluid, etc.
5. Close and secure the engine cover.



9.12.5 Transmission Mounted Speed Sensor

The transmission speed sensor is located at the left side of the transmission below the transmission filter.

a. Transmission Mounted Speed Sensor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Unplug the speed sensor sender (10) connector from the wiring harness connector.
6. Loosen the screw holding the clamp and remove the sensor, clamp and o-ring.

b. Transmission Mounted Speed Sensor Inspection and Replacement

Inspect the sensor and the wiring harness connector terminals for continuity. Replace a defective or faulty sensor with a new part.

c. Transmission Mounted Speed Sensor Installation and Testing

1. Install new o-ring on speed sensor, install sensor in transmission, install clamp on sensor, bolt down clamp, turn arrow on sensor 45 degrees from clamp bolt and torque to 8-10 Nm (70-88 lb-in).
2. Connect the sensor plug to the wire harness.
3. Connect the battery negative (-) cable to the battery negative (-) terminal.
4. Close and secure the engine cover.

9.12.6 Engine Coolant Temperature Sender/Switch

The engine coolant temperature sender/switch is located by the alternator.

a. Engine Coolant Temperature Sender/Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Unplug the engine coolant temperature sender/switch connector from the wiring harness connector.
6. The sender/switch is threaded into the engine block. Remove the sender.

b. Engine Coolant Temperature Sender/Switch Inspection and Replacement

Inspect the sender/switch and the wiring harness connector terminals for continuity. Replace a defective or faulty sender/switch with a new part.

c. Engine Coolant Temperature Sender/Switch Installation and Testing

1. Thread the engine coolant temperature sender into the engine block snugly, then connect the sender/switch connector to the wiring harness connector.
2. Connect the battery negative (-) cable to the battery negative (-) terminal.
3. Check for proper coolant level.
4. Start the engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If the sender/switch is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument display, etc.
5. Close and secure the engine cover.



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9.12.7 Engine Oil Pressure Sender

The engine oil pressure sender is located below the injector pump.

a. Engine Oil Pressure Sender Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Unplug the engine oil pressure sender connector from the wiring harness connector.
6. The sender is threaded into the engine block. Remove the sender.

b. Engine Oil Pressure Sender Inspection and Replacement

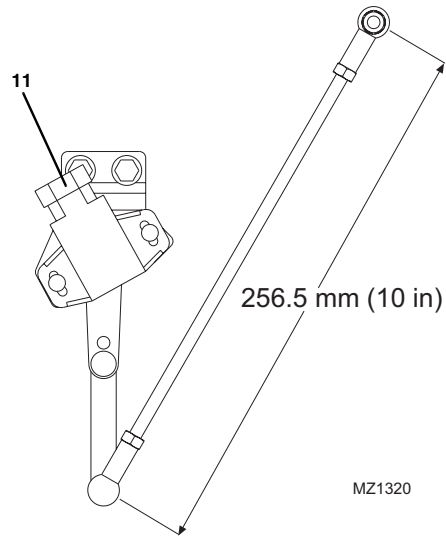
Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

c. Engine Oil Pressure Sender Installation and Testing

1. Thread the engine oil pressure sender into the engine block snugly, then connect the sender connector to the wiring harness connector.
2. Connect the battery negative (-) cable to the battery negative (-) terminal.
3. Check for proper oil level.
4. Start the engine, and observe the operator's display for warning indication. If the sender is not defective, the problem could be elsewhere; possibly in a a shorted wire, improper-running engine, low oil, obstructed or faulty oil pump, defective instrument display.
5. Close and secure the engine cover.

9.12.8 Boom Angle Sensor

The boom angle sensor (11) is located at the top left inside rear of the machine.

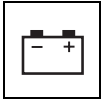


a. Boom Angle Sensor Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Disconnect the boom angle sensor electrical connector.
6. Loosen and remove the nut holding the rod assembly to the sensor arm.
7. Loosen and remove the two bolts holding the sensor to the sensor seat.
8. Remove the sensor assembly.

b. Boom Angle Sensor Inspection and Replacement

Inspect the sensor and the wiring harness connector terminals for continuity. Replace a defective or faulty sensor with a new sensor.



c. Boom Angle Sensor Installation

1. Install the sensor assembly to the sensor seat and tighten both bolts.
2. Install the rod end to the sensor arm and tighten nut.
3. Measure and set rod length to 256 mm (10 in) if needed.
4. Plug the electrical connector into the sensor assembly.
5. Connect the battery negative (-) cable to the battery negative (-) terminal.
6. Close and secure the engine cover.

d. Boom Angle Sensor Adjustment

1. Access Level 2 can be reached by pressing buttons **C** and **OK** at the same time.
2. Access level 2 consists of the following menu items:
 - Anti-theft device
 - Software-version
 - Learning
3. The following submenus can be found in the Learning Menu:
 - Boom
 - Vehicle Speed
4. After choosing "Boom" the analog values of the boom angle sensor for the upper and lower limit positions get determined and taken over.

The range detection of the analog values for the boom must be performed for the boom angle sensor in order to allow a precise calculation of the boom angle.

Firstly, the upper analog value is learned. When the boom is moved upwards (joystick Y-axis moved to the back) one can see the analog value gets higher. At the upper limit position of the boom the value gets confirmed by pressing the **OK** button and the learning of the lower limit position can be started. When the boom is moved downwards (joystick Y-axis moved to the front) the value decreases. At the lower limit position the value needs to be confirmed with the **OK** button and one comes back to the Learning menu.

Conditions for the value range:

- If the lower value is outside the range of 70-330, a value of 100 is taken over.

- If the upper value is outside the range of 550-850, a value of 800 is taken over.

5. If either the lower value (100) or the upper value (800) is shown, the boom angle rod may need adjusted.

9.12.9 Ignition Key Switch

a. Ignition Key Switch Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the lower dash panel.
6. Remove the hex nut securing the ignition key switch to the dash.
7. Reach up and under the dash to work the ignition switch and wiring out of the mounting hole.
8. Disconnect the ignition switch connectors from the cab harness connectors, and remove the switch from the machine.

b. Disassembly

DO NOT disassemble the ignition key switch. Replace a defective switch with a new part.



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c. Inspection and Replacement

To determine the proper operation of the ignition key switch, using the following chart, test the wires on the back of the switch for continuity with an ohmmeter.

Test the ignition key switch for continuity, by checking from the ignition (**#30**) wire to each of the following wires in each switch position. Continuity (**X**) should be present as indicated in the following chart:

Switch Position			
Test from #30 wire to:	OFF	RUN	START
Wire #15		X	X
Wire #50			X

If all connections do not show proper continuity, replace the ignition switch.

d. Ignition Key Switch Installation

1. Connect the ignition key switch to the cab harness connectors.
2. Reach up and under the dash to work the ignition key switch into the ignition key switch mounting hole on the dash.
3. Align the ignition key switch
4. Connect the battery negative (-) cable to the battery negative (-) terminal.
5. Close and secure the engine cover.

9.12.10 Fuel Level Indicator and Fuel Level Sender

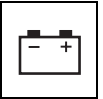
a. Fuel Level Indicator Testing

1. The fuel level sender wiring harness leads can be accessed from the top of the fuel tank. Disconnect the fuel level sender wiring harness leads. With the help of an assistant, touch both harness leads together.
2. From the operator's cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster.
3. Turn the ignition key switch to the OFF position. The fuel level indicator needle should return to the EMPTY position.

b. Fuel Level Circuit Tests

If the fuel level indicator is suspected of giving a false reading, perform the following checks:

1. If the fuel level indicator needle does not move, check the fuel tank for fuel.
2. Check for loose or defective wiring, faulty ground connections or corrosion on the fuel tank sender and wiring lead.
3. If the fuel level indicator needle does not move after the ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from the ignition switch to the fuel level sender.
4. If the fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out and in addition, wiring and connectors have been checked and ruled out, the fuel level indicator is defective and must be replaced.
5. Check that the ignition terminal has current and that the fuse in the fuse panel is not blown.
6. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the cab, fuse and relay panel, ignition key switch and from the fuel level sender on the fuel tank through the wiring in the cab.
7. Check the fuel level sender. The resistance of the fuel level sender is 31 ohms for a full tank of fuel, 101 ohms for 1/2 tank and 255 ohms for an empty tank. A defective fuel level sender in the fuel tank may also prevent the fuel level indicator from moving.



9.13 DISPLAY MONITOR AND GAUGES

9.13.1 Analog Gauges

The machine is equipped with an analog engine coolant temperature gauge and a fuel level gauge. The engine coolant temperature also is displayed on the display "Main Screen".

a. Removal

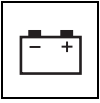
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel, stating that the machine should not be operated.
3. Open the engine cover. Allow the engine to cool.
4. Disconnect the battery negative (-) cable at the battery negative (-) terminal.
5. Remove the lower dash panel, unplug connectors from the gauge, remove the two nuts and lock washers along with the gauge bracket.
6. Pull the gauge out from the front of the dash.

b. Disassembly

DO NOT disassemble the gauge. The gauge is not serviceable. Replace the gauge if found to be defective.

c. Installation and Testing

1. Install the gauge in the dash. Install the gauge bracket, lock washer and nuts. Connect the wire connections.
2. Connect the negative (-) battery cable to the negative (-) battery terminal
3. Turn the ignition to the ON position to check the fuel level. If gauge is not reading properly refer to Fuel level sender section
4. Start the machine and allow the engine to warm to check the engine water temperature.
5. Close and secure the engine cover.



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